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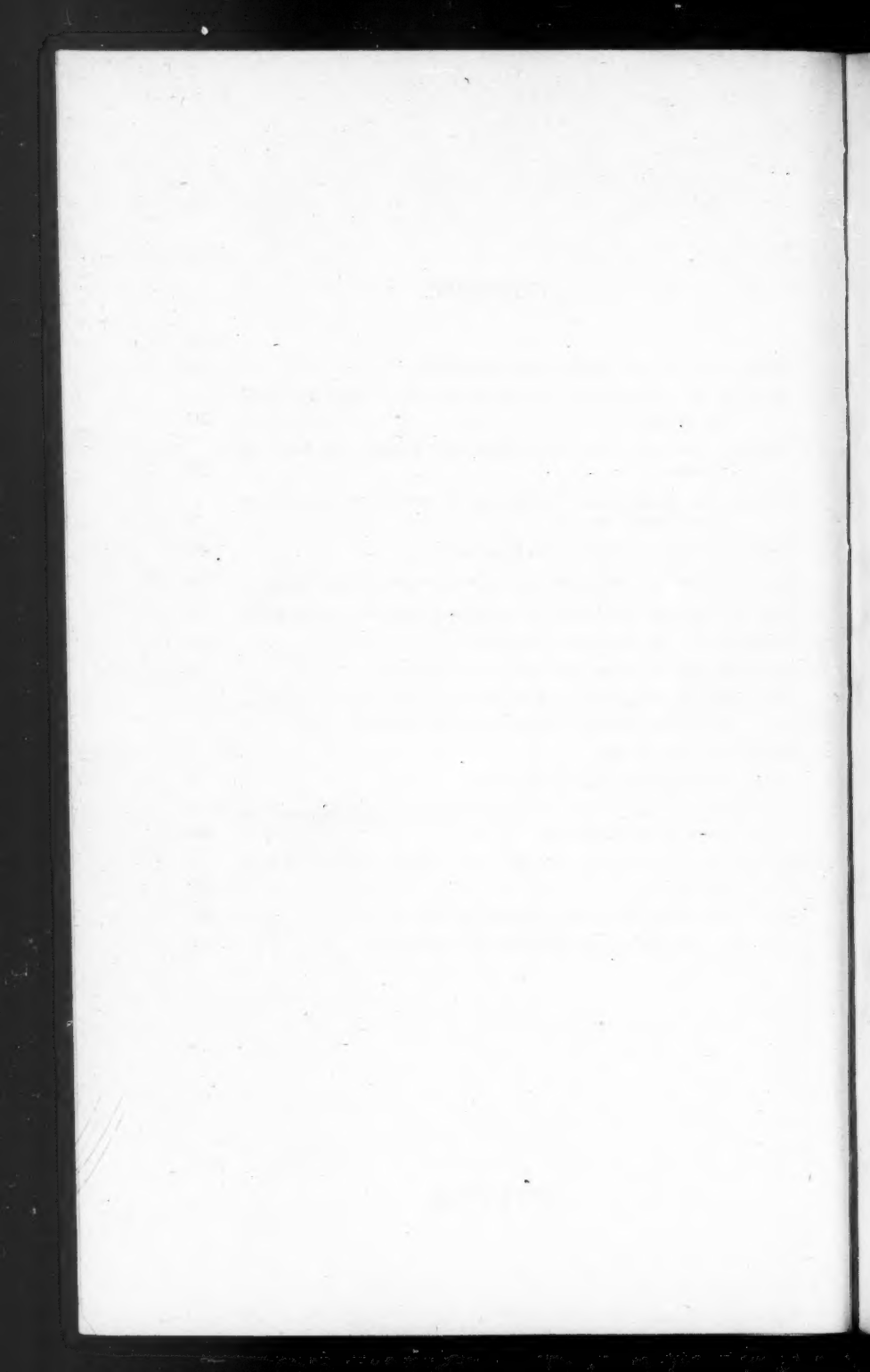
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INTRODUCTION

Psychology has not yet reached the stage of having its boundaries precisely determined nor has it yet an established method of research. While viewing the various and diverse problems and methods peculiar to this science, particularly the lack of clarity regarding its basic philosophical assumptions, one speaks of a crisis in psychology. The word 'crisis', however, does not sum up the actual position of psychology today. As a science, in the widest sense of the term, it is comparatively young, with a history of progressive development. Though the main problems which it undertook to consider have not been abandoned, they are not of much consequence to the tasks undertaken by the younger psychology.

The last decades indicate a line of advance which is by no means at an end. It consists of changes and an amplification both of which point to the need of collaboration between the various schools of psychologists. It is not our intention to appeal against the present differences in the various view-points of these schools. (Such an intention would not be desirable, even its fulfilment were possible.) Our intention is to provide a common platform for the research workers to acquaint them with one another's problems and lines of thought and thus serve the fundamentals of our science. It was with that intention that *Acta Psychologica* was conceived.

We offer the publication after six years' silence. It is our hope that *Acta Psychologica*, with generous help from our distinguished contributors from the various countries, will serve its self-appointed task better than before.

G. RÉVÉSZ

INTRODUCTION

The purpose of this study is to investigate the effects of the various factors which influence the rate of the reaction between hydrogen and oxygen. The rate of the reaction is measured by the volume of gas evolved per unit time. The factors which are investigated are the concentration of the reactants, the temperature, and the presence of a catalyst. The results of the experiments are discussed in the following chapters.

The first chapter describes the apparatus and the method of experiment. The second chapter discusses the results of the experiments on the effect of concentration on the rate of the reaction. The third chapter discusses the results of the experiments on the effect of temperature on the rate of the reaction. The fourth chapter discusses the results of the experiments on the effect of a catalyst on the rate of the reaction. The fifth chapter discusses the general conclusions of the study.

The results of the experiments show that the rate of the reaction increases with the concentration of the reactants, with the temperature, and with the presence of a catalyst.

COLOUR MIXTURE AND SOUND MIXTURE

by

G. RÉVÉSZ

Contents:

1. Current conceptions of the relations between optical and acoustical phenomena.
2. Colour mixture.
3. Sound mixture.
4. Dualistic theory of sound perception.
5. Phylogenetic considerations.
6. Audition theories and their relation to normal and pathological phenomena in acoustics.
7. Summary.

I

In studying the relations between optical and acoustical phenomena, physiologists and psychologists have laid special stress on the fact that, according to experience, colours can be mixed, but not sounds. This is what Johannes von Kries, a well-known German physiologist states in his „Die Gesichtsempfindungen“, Handbuch der Physiologie des Menschen, III, 1905: "The profound significance of this fact" — i.e. that the mixing of two colours of the spectrum results in a mixture lying between the two colour impressions — "becomes obvious when we remember the entirely different phenomena in the field of audition. Sound the notes *c* and *e* simultaneously and you will hear both of them, the sensation being positively different from the one produced by a tone of medium frequency, such as e.g. *d*."

There is no objection against this statement: two sounds of different frequency produced simultaneously will not give a "mixed sound", but a chord or a discord consisting of two distinguishable components. Harmonic music would be quite impossible, if the sounding of the note *c* together with its 5th

instead of a chord, gave a new intermediary sound, as for instance an *e*.

This discrepancy, existing between the optical and acoustical phenomena, accounts for the fact that so far no attempt has been made at a general physiological theory which might include the two senses.

II

Now the question arises whether a sound mixture is really impossible, or whether it might be produced under special conditions. To answer this question colour optics have to be considered first. Let us, therefore, find out on what conditions a colour mixture occurs in the optical field.

When mixing yellow of a wave length of about $577 \mu\mu$ with green of about $500 \mu\mu$, the mixture will appear absolutely identical with a spectral colour of intermediary wave length. The exact nature of the new colour will depend on the proportion in which the components are represented in the mixture. (If yellow prevails by greater intensity, the mixture will be nearer to this colour, whereas in the opposite case the resultant colour will shift towards the short waves of the spectrum. It goes without saying that such a combination of colours can result from mixing bands of a prismatic spectrum, or of polarised light as well as from mixing pigments or glass filtered monochromatic light.)

Moreover, it is well known that colours can be brought to cover not only in monocular, but also in binocular vision. When looking through a stereoscope or through an achromatic prism at two differently coloured visual fields in such a fashion that both cover each other we perceive a single colour, intermediary to the two monocular colours. Special precautions are of course necessary such as to eliminate competition of visual areas. It is admittedly more difficult to elicit this phenomenon than to obtain monocular mixture, owing to the needed modifications and restrictions. Furthermore there exists a disagreement of rules applying to mono- and binocular colour mixtures. But all these details have nothing to do with the *phenomenon of mixture* itself whose existence and perceptibility may be realized by everybody.

Colour mixtures are obtained under the following *physiological conditions*:

Monocular colour mixing presupposes simultaneous stimuli by two or more colours affecting the same retinal area, specially the fovea centralis. Mixture, therefore, is incident to *identical spots* of the fovea being exposed to different colours; heterogeneous spots being exposed to such colours would convey separate colour sensations. Our perception is so organised that every single colour-sensitive foveal element can specifically and independently respond to perceptible light; in other words, every kind of homogeneous light can elicit a corresponding colour sensation by affecting one of the peripheral nerve terminals of the central visual apparatus. (Every colour-sensitive retinal element can functionally represent the whole of the fovea centralis, as *pars pro toto*.)

Binocular colour mixtures are due to stimulation of corresponding areas of the two retinas. Otherwise separate colour sensations will be conveyed. A mixture, therefore, depends on the spatial arrangement of the colour stimuli: monocular mixture presupposes stimulation of identical, binocular mixture that of corresponding points. It is assumed that either by a monocular stimulus exercised upon identical retinal areas or by a binocular stimulus upon corresponding ones a certain central sense sphere is affected. This process may be considered as the physiological basis of colour mixture.

If we allow ourselves to be guided by the genetic condition valid in the physiology of colour mixture, it might, in theory, be possible to bring about a mixture of sounds if we succeeded in stimulating areas of the peripheral or central auditory organ identical in one ear or corresponding in both ears. But sound perception is so organised that it can neither anatomically nor functionally fulfil this requirement.

Colour optics may once more help to show a new approach to the problem.

It is generally known that binocular colour mixtures may arise from two colours simultaneously acting on each eye as well as from a natural or artificial adaptation of one eye (caused e.g. by coloured glasses). For example: Exposure of the right eye to red light makes it especially sensitive to green. Looking alternately with the adapted right eye and the unadapted left

eye at a yellow surface will produce a greenish-yellow hue for the right eye, whereas the left eye will perceive a normal yellow. A binocular combination of the two colour impressions creates a colour impression which normally lies between the two monocular colours.

A similar phenomenon based upon the disagreement of the two ears, is a disorder known as *paracousis*.

In connection with paracousis the following problem arises: If there exists a disagreement between the normal and the paracoustic ear similar to that between the normal and the adapted eye, will then the same sound stimulus, if presented to each ear at a different time, cause different sound impressions? And will it, if presented to both ears simultaneously, produce a tonal quality lying between the sounds perceived by each ear separately?

III

I have had an opportunity to put these theoretical considerations to the test, when I gained access to a case of paracousis.

The patient, endowed with a reliable relative and absolute musical ear, perceived wrongly a certain musical range, with a difference existing between the two ears. The faulty hearing of the patient began at c^2 and extended over the whole musical range upwards. This case of binaural hearing presents, as it were, a repetition of the genetic conditions of binocular colour mixture with one eye being chromatically adapted: *one and the same sound was perceived differently by each ear*.

Here the first problem was to test the tonal sensations of the affected ears separately; the second question was to find out how these tonal sensations, differing on separate presentation to each ear, would be heard under simultaneous presentation to both ears. It was expected that a fusion into a mixed sound would arise. This expectation was justified by the results.

In order to provide an accurate idea of the nature of this disorder, the course of testing these pathological conditions is here reproduced.¹⁾

¹⁾ Compare the investigation of this case of paracousis and of the pertinent phenomena in: Zeitschr. f. Psychologie 48. 1908, 63. 1912 and 69. 1913.

The following experiment was executed:

A tone was chosen which by the left ear was heard at a different pitch from the right. This sound was received by a funnel and led by two tubes across a few rooms to the observation chamber. Rubber tubings connected these leads with the ears of the patient. For continuous alteration of the intensity of monaurally perceived sounds the tubings were provided with clips, a device permitting complete blotting out of the sound if so wanted.

Two testing methods were employed for the determination of the sounds heard, the one taking advantage of the absolute ear of the patient, the other of his appreciation of intervals. No commentary is needed on the first method. The second method consisted in the successive comparison between the pathologically altered sound whose pitch was to be determined, and a tone out of the normally perceived range, in order to judge the interval. In order to characterise e.g. the "pseudo-tone" c^3 heard by the left ear, the following intervals, formed by a lower normal tone plus the altered c^3 , were tested:

From	To	Interval assessed by the patient
fis^2	$- c^3$	major 3d
f^2	$- c^3$	4th
e^2	$- c^3$	augmented 4th
es^2	$- c^3$	5th
d^2	$- c^3$	minor 6th

Therefore the left ear constantly heard c^3 a major 2nd lower; the "pseudo-tone" c^3 thus had the quality of b^2 flat ²⁾.

In the next table the results of such a test series are reported in extenso. Here the tones of an organ were used for the determination of pitch by the more severely affected left ear.

²⁾ In most cases of paracousis known from otological literature, a different reaction of the patients was observed, each single tone differing by the same interval from the normal tone. Merely Daae's case is rather like ours. His patient perceived all the tones as an f as long as they had vibration frequencies between 128 and 2048 (about c to c^4). Zeitschr. f. Ohrenheilkunde 25. p. 261.

True tones	Qualified by absolute and interval hearing	True tones	Qualified by absolute and interval hearing
gis ²	g	f ³	bes
a ²	a	fis ³	bes
bes ²	bes	g ³	bes
b ²	bes	gis ³	bes
c ³	bes	a ³	bes
cis ³	bes (later a)	bes ³	bes
d ³	bes	b ³	bes
e ³	bes	c ⁴	c

Thus all tones between *bes*² and *b*³ were heard as *b* flat. From the preceding description we pass on to our real problem. Our first task was to find out whether in the pathological area, i.e. between *bes*² and *b*³, there existed a distinctly perceptible difference between both ears or, more correctly, between the tones perceived by each ear. If this were the case, we compared the tone heard by the right ear with that heard by both, and then again the latter with the tone perceived by the left ear. When the binaural quality proved to be *intermediary* to the monaural qualities, then the shifting from left to right and from binaural to right had to appear as a progression in the same direction and the shifting from right to left and from binaural to left as a progress in the opposite direction. And, in fact, this proved to be the case.

The steps from binaural to monaural hearing have of necessity to be smaller than the steps from left to right, and vice versa.

Is the tone *d*³ presented first to the left and then to the right ear, the difference of pitch amounts to a somewhat too large descending half tone. But when it is presented first binaurally and then to the right ear, the difference comes up to a somewhat too small descending half tone. When on the other hand, we proceed from the right to the left ear, the interval proves an ascending minor 2nd, and when proceeding with a presentation first to both ears and then to the left ear the interval proves a somewhat too small ascending half tone.

Almost all the tones were characterised according to expect-

ation, namely the *binaural tone seemed intermediary to the separate monaurally heard tones*. Contradictory judgements, placing the binaurally heard sound outside the range between the monaurally heard ones, were never encountered in these tests.

From the evidence that on the one hand two monaural tone perceptions were distinctly different and that on the other hand the two impressions were blended into *one* whose sound quality was *intermediary* to both monaural sensations follows, that *mixed tones actually exist*. I for one contend that any other explanation is inadequate for the complete disappearance of the monaural tones and the appearance of a single constant intermediary binaural tone. Moreover, this interpretation is borne out by its agreement with that of colour mixtures. Further detailed evidence will be given in the following.

In conclusion, we may say that *binaural sound mixtures exist as well as binocular colour mixtures*³⁾.

In order to increase the exactitude of observations, and the convincing power carried by the interpretation and furthermore to penetrate deeper into the nature of the phenomena of sound mixture, it was decided to determine not only the fact, but also the quantitative conditions of sound mixture, i.e.: the binaural tonal quality as to its position in the normal musical range.

The exact quality of the binaural tone was determined by asking the patient to adjust, with the aid both of a reliable acoustical instrument and his absolute ear the lower 5th of the note sounded to him. Monaural tone perceptions were similarly determined⁴⁾.

The test-tones and tones for comparison were alternately sounded. If the binaural tone lay between the two monaural ones, its 5th had to take a similar position between the 5ths of the monaural sounds. Thus it was possible to express in terms

³⁾ I readily agree with *Carl Stumpf* that sound mixture would be more evident if its phenomena had occurred within the difference of a 5th vibration rather than within a frequency difference of 20—30 between two ears. (*Zeitschr. f. Psychol.* 75, p. 330). But that did not depend on us, but on the pathological state of the patient. However, I do not want to imply that a mixed tone would have arisen with such a great difference.

⁴⁾ It is perhaps useful to repeat that the lower 5ths lay already in the normal unaffected area.

of frequency of vibration p.s., *quantitatively*, the qualitative difference existing between monaural and binaural hearing.

The 5th of the binaural tone was invariably found to lie between the fifths of the monaural tones, so that in each case sound mixture resulted. Moreover, when the intensity of the two monaural perceptions was *equal*, then the corresponding vibration frequency of the binaural tone would coincide with the average of the corresponding frequencies of the monaural tones ⁵⁾.

To demonstrate this, a table is here presented showing the average figures derived from numerous judgements.

Vibration frequency of note sounded	Lower 5th in normal range			AM between left and right tone	Difference between binaural tone and AM
	right	binaural	left		
760	443,3	449,2	452,5	447,8	1,4
767	438,8	448,7	452,5	445,7	3,0
800	443,3	447,4	452,8	448,1	0,7
812	444,4	448,5	453,8	449,1	0,6
845	443,0	449,7	452,0	447,5	2,2
861	447,8	454,2	457,3	452,6	1,6
Average	443,0	449,6	455,1	448,5	

According to these results it was to be expected that whenever the monaural sensations were of *unequal* intensity the binaural tone would approach the stronger component the same as in colour mixtures the resultant colour shifts towards the more intense component when colours of a different intensity are mixed. In fact, the binaural tone could be shifted by changing the intensity of the monaural tone. Thus any mixture qualities could be produced within the range between the two monaural tones.

In view of the theoretical importance of the phenomenon of sound mixture I tried to obtain the same phenomenon under *normal conditions*.

⁵⁾ There is no difference here between the arithmetic and geometric means.

	Downwards 5ths of Sound with					
	760 vibration/"			825 vibrations/"		
	right	binaural	left	right	binaural	left
			lower fifth			
right much stronger		437,5			443,3	
right stronger		440,2			449,5	
both sides equal	436,0	444,5	452,5	442,5	451,5	457,5
left stronger		448,0			452,2	
left much stronger		449,5			454,0	

For that purpose experiments were carried out with musically gifted *normal persons*, in a similar manner as those with the patient⁶⁾. Soon it became apparent, that many of our normal test persons had latent differences between the sound perceptions of their two ears, especially in the high range of notes, somewhere near b^2 (about 1000 vibrations/"). Often the difference would scarcely surpass the threshold of perception; but in some of the cases it amounted to a minor 2nd. These differences remain usually unobserved by musically gifted persons, for on binaural audition the difference is halved, and thereby reduced to negligibility, but also because small discrepancies usually remain unobserved. The "normal" persons heard a qualitative difference between the perception of the same note sounded to their ears monaurally *in succession* whenever the monaural difference was appreciable. Sounding the same note to both ears *simultaneously*, a tone of intermediary character was reported lying between the monaural quality. By suitable variation of the respective intensities, the binaurally heard tone can be shifted within monaural qualities, just as described above in the case of the patient. The binaural tone usually was lying close to the tone heard by the ear more strongly affected.

Hence it follows, that sound mixtures is a *general acoustic phenomenon*. Although certain pathological disorders may greatly facilitate its detection, sound mixture may also occur in normally hearing persons after application of adequate means. It may seem regrettable that the binaural difference of tone sensation did not exceed in my case a minor 2nd at the time of these experiments, but that does not in the least impair

⁶⁾ VIth Congress of Experimental Psychology, Berlin, 1914.

the positive result of our experiments with respect to tone mixture. The definite and unfaltering statements of musically gifted subjects who underwent the tests, as well as the absence of contradictory observations do not leave any doubt as to the reliability of the observations and the correctness of our interpretations⁷⁾.

A few additions are necessary here as to the tonal character of the mono- and binaural tones. In this context the following question arises: Are the monaural tones as well as the mixed tone produced by them equivalent in every respect to the normally heard tones? In no way. To explain the difference, it is necessary to refer to the fundamental characters of tones, as described in my „Grundlegung der Tonpsychologie”, (Fundaments of Tonal Psychology)⁸⁾.

IV

In my dualistic theory of sound perception two fundamental characters of musical tones are pointed out: Musical sounds have a *pitch* continuously changing with the frequency of vibrations over the whole musical range, and they have *quality* (octave quality) repeating itself from one octave to the other, with the duplication of frequency. Their pitch fits the tones into a continual range running in *one* direction from the lowest to the highest tones. By contrast, the tonal qualities form a periodically *reiterated* series, the same quality reappearing once in every octave at various pitches. *Pitch is a linear, quality is a periodical function of sound vibrations.* According to this conception c^1 , c^2 ,

⁷⁾ Stumpf attempted to explain the phenomena of mixture by binaural difference limina, but this assumption is invalidated by the facts, that on the one hand a binaural tone, actually different from the monaural ones, has been observed and that its quality has exactly been determined; on the other hand that by varying the intensity of the two monaural tones the binaural tone could be shifted. In the case above presented, not merely a monaural duality has been observed, as Stumpf emphasizes on the ground of the investigations made by his pupil Baley (Zeitschr. f. Ps. 70, p. 340), but also a binaural unity in the character of an intermediary tone.

⁸⁾ G. Révész, Die Grundlegung der Tonpsychologie, Leipzig 1912.

—, Zur Geschichte der Zweikomponententheorie, Z. f. Ps. 99, 1926.

—, „Tonsystem” jenseits des musikalischen Gebietes, etc. Z. f. Ps. 134, 1935.

—, Einleitung in die Musikpsychologie, Bern, Francke 1946.

c^3 are tones of the same quality, but of unequal pitch, whereas c^1 , f^1 , d^2 represent both pitch and quality differences. As a result of this dualism, there is always a double interrelation between two tones. One of these is qualitative, the other metrical. Qualitatively the 3d (c^1-e^1) is equal to the 10th (c^1-e^2); but the 3d (c^1-e^1) is different from the 4th (c^1-f^1) metrically e.g. the 5th (c^1-g^1) and (d^2-a^2) are equal and the 10ths as (c^1-e^2) different. Letters (c , d , e ...) denote the quality of sounds, figures designating the octaves mark the pitch (c^1 , c^2 , c^3 ...).

According to the dualistic theory each musical tone consists of *two components*. These are so inseparably blended that they cannot be phenomenally distinguished. Thus, one is not able consciously to make a difference between quality and pitch of each tone, as e.g. to get an independent impression of the c -quality of c^1 . Similar conditions prevail in optics. In the colour sensation conveyed by looking at an orange, it is impossible to distinguish the component colours, red, yellow and white. This fact is opposed to the observation of spatial components, e.g. in drawing, whose integral structure can easily be differentiated into its component parts.

In the integral tone impression the components can be observed only when the tone is opposed to, and compared with, another one. Only then it is possible to say that e.g. e^1 is higher than, and qualitatively different from c^1 .

Exactly the same applies to colours. In the colour of an orange the chromatic (red, yellow) and the achromatic (brightness, whiteness) components are distinguishable only by means of a comparison with another, different looking colour. From the viewpoint of phenomenal independence, there is much difference between the quality and the pitch of a tone. The quality of tone is a dependent character, inseparably attached to tonal pitch; c - or d -tones without pitch can exist just as little as the colours red, yellow, green could exist without brightness. Every audible tone will fit into the range of pitch, i.e. it will lie either higher or lower than another tone; likewise every colour tone has its place in the white to black range of brightness, every colour is either brighter or darker than another colour. On the other hand, tonal pitch may occur independent of quality. Certain percussion instruments, such as e.g. drums, produce sounds of a certain pitch but without tonal quality. Two differently tuned

drums are distinguishable by their pitch, but it is impossible to state whether they produce a c-, d- or e-tone⁹⁾.

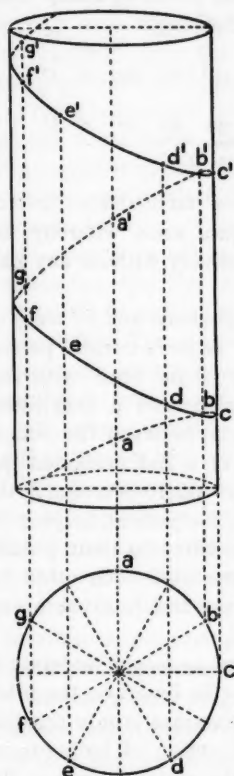
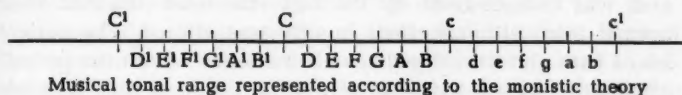
Likewise the tones audible beyond the highest and lowest tones of the musical range, possess pitch but no quality. This is demonstrated by the impossibility to find an octave or a 5th to such a tone within the musical range. Similar conditions are encountered in the realm of visual sensations, where brightness exists without colour (gray tone), but — as already stated — no hue without brightness. (As no tonal quality exists without pitch, no real, but merely a virtual existence can be ascribed to this tonal character. Despite its virtual character and its insoluble union with pitch, tonal quality does "exist" and asserts itself most distinctly by its repetition and different pitches in the phenomenon of octaves.)

The difference between dualistic and monistic theories (Helmholtz, Stumpf etc.), is clearly expressed in their respective graphs. The monistic theory of hearing reduces the variety of our tonal sensations (except timbre and intensity) to a variation of pitch, as to a single character varying continuously. In the monistic theory the graph of the musical range is a *straight line*, expressing upward and downward movement; it is contended that such a line exhausts the characteristic tonal differences. At variance with this conception, the dualistic theory puts emphasis on the straight up and down movement of pitch, but combines with that the continual periodicity of the range of tonal qualities; the double character is adequately expressed by a *spiral*. The constant direction of the series of pitch is expressed by a continuous progress of the spiral from its beginning. The periodicity of the series of qualities is expressed by the points corresponding to the octaves lying one above the other.

A spiral, so constructed that one complete winding represents an octave, would imply that all the c-tones lie on a vertical line (C², C¹, C, c, c¹, c², c³ etc.), all the d-s and all the e-s likewise on parallel vertical lines of their own. In one respect the octave would be at a maximal distance from the key tone as compared to other intermediate tones (measured by the distance between the first and the eighth tone on the spiral); in another respect

⁹⁾ In musical notation this is expressed by noting the drums in the score, not on a five staved system, but on a single line.

the octave would lie nearest to the key tone (measured by the distance between the first and the eighth tone on the vertical).



Representing the
dualistic theory

By separation of two fundamental tonal characters, a sharp distinction arises between two perceptions of acoustic-musical relation viz. the *tonal distance* and the *interval-quality*.

By *distance* a difference of pitch should be understood, as experienced in the phenomenon of ascent in the range. A distance is the larger the farther the limiting tones are in the musical range. Thus the distance between c^1 and g^2 is smaller than that between c^1 and g^3 .

Interval-quality on the other hand depends on the quality of the two tones. The quality of the interval c^1 and g^2 is the same as between c^1 and g^3 , since both intervals are composed of equivalent pairs of tones (c - g) between tonal distance and interval quality the difference is similar to that between pitch and quality of tone. Tonal distance is an independent sensation of relation, whereas to interval quality a real existence is imparted by the musical interval only, which, on its part, forms a combination between tonal distance and qualitative difference. That a qualitative tonal relation is inseparable from distance (the metric tone relation) follows from the inseparability of tonal quality and pitch, as already mentioned.

After these theoretical considerations, it seems easy to understand my patient's case of paracousis. He had, as already mentioned, a pathologically altered tonal range, which lay between

g^2 sharp (830 vibrations/"') and d^3 (1177 vibrations/"'); above and below this range, hearing was normal. The pathological area was characterized by the fact that tones retained their normal pitch although their quality was altered. The patient heard both and named g -sharp all the tones within the pathological area (from g -sharp² to d^3), but at the same time he made the most peculiar experience that all these pseudo- g -sharp tones kept the pitch of before the disorder of hearing.

True tones	fis^2	g^2	gis^2	a^2	ais^2	b^2	c^3	cis^3	d^3	dis^3	e^3	f^3
were												
qualified as	fis^2	g^2	gis^2	gis	gis	gis	gis	gis	gis	dis^3	e^3	f^3
				pathological area ¹⁰⁾								

The constant change of pitch became particularly obvious during a glissando within the pathological area, whereby the impression of an ascent or descent respectively without any halt was conveyed.

For the patient all the tones between g^2 sharp and d^3 were as equivalent (they were all g sharp-tones) as for a normal person the octaves will be (such as g^2 sharp, g^3 sharp etc.), with one difference, the distance between the successive g sharp-tone appearing much smaller than the distance between the octave tones. His sensation was as if distances of a 2nd possessed the same quality, comparable, as it were, to micro-octaves. After a presentation of a^2 and d^3 in succession, the patient, relying on his absolute ear, judged these tones, according to their pseudo quality, as two g sharp-tones, but distant from each other by a fourth. He experienced this relation as the interval of an octave, but with a shorter distance.

At first sight even musical people can by no means understand these tonal judgements. How can a tone c be heard on the pitch of f^1 or g^1 ? To experience these tonal impressions is only possible by distinguishing clearly between the function of both fundamental characteristics which determine the musical tones in the formation of intervals, and by remembering that all c tones

¹⁰⁾ The pitch of the g -qualities between the notes e^2 and d^3 are of course different; they have normal pitch, agreeing with the real tones. The first pathological tone gis lies on the pitch of a^2 , the second gis on the pitch of ais^2 , and so on.

differ merely by their pitch or height distance. In this case it is no longer difficult to imagine a tonal range in which the octaves cover a smaller distance of pitch than usual.

No specially strong capacity of abstraction is needed in order to imagine that between the tones c^1 (261 vibr./") and c^2 (523 vibr./") instead of one octave lie two octaves, and that inside each of these micro-octaves all familiar intervals are contained, merely at a smaller distance. Interval-qualities, such as 5ths, may persist, only the distance, the grade of ascent from the fundamental note to its 5th will be abnormally small.

This is not merely an imaginary conception. Closer observation of our tonal range shows that in the low part of the musical range, at the contra and bass level equivalent intervals, say 4ths or 5ths, are *smaller* than in the high range, especially in the octaves between c^2 and c^3 . A person with a good relative ear will always recognize correctly the interval g^1 to a^2 -flat as a minor 9th, but the same person may occasionally take the interval G^1 to A -flat for a minor 2nd (G^1 to A^1 -flat), instead of a minor 9th. The distance between G^1 and A -flat is so small compared with g^1 to a^2 -flat, that the first would under certain conditions seem a 2nd instead of a 9th.

Still more striking is another experiment. Let a musically gifted person hear the equivalent intervals c^2 to g^2 and C to G , by successively sounding the notes in upwards direction and he will always recognize the ascending interval c^2 to g^2 as an ascending fifth whereas the likewise ascending interval C to G will occasionally be perceived as a descending fourth C to G^1 . In any case, the interval C to G can be heard as a descending fourth whereas such an inversion of c to g is entirely out of the question in consequence of the greater distance.

Our case loses much of its curiosity when reconsidered after these various observations. As a result of a central disorder the patient has lost his capacity of perceiving a certain range of tonal qualities, with the exception of one: in other words: the different pitches have been suffused with one tonal quality. A series of micro-octaves were formed, so to speak, i. e. identical qualities with abnormally small distances were created. Therefore, when the patient characterizes the tone c^3 in the pathological range as follows: "I hear a g -sharp, but not at the familiar pitch of g^1 "

sharp, or c^2 sharp but rather between these two at a pitch where I was used to hear c^3 , he gave an accurate description of his tonal perception exactly fitting in with the dualistic theory.

Returning to our actual subject, we need no longer go into details. In our case the tonal impression differed upon both ears; the difference was mainly related to tonal quality whereas the pitch remained constant.

V

The qualitative change of tones without a change of pitch in sound mixtures or in binaural hearing in general, may be explained on an *evolutionary* basis.

Pitch appears to be a more original characteristic of our sound perception, philogenetically both and ontogenetically older than tonal quality. The primacy of pitch also explains the occurrence of tones without quality, whereas tonal quality is necessarily linked with pitch. One might as well assume, that in the *philogenetic evolution of the sensory system* there was a stage at which sound sensations, with the exceptions of rhythm, intensity and directions were confined to distances of pitch. Such a view is borne out by the lack of tonal-quality as well as of interval-quality in unmusical persons, in young children and probably in all animals. Unmusical persons perceive no difference of quality but merely of pitch between octaves and 7ths or 9ths respectively. Such persons have no sensation of octaves on which our whole musical system is built, which forms the key-stone of all melodic and harmonic music. All they hear is difference of pitch, and in this respect the difference between octave and minor 9th or major 7th is moderate, so that they can be easily confounded. The same applies to children during their first years of life. It should be understood that the realisation of qualitative differences is connected with the realisation of stable intervals, themes, and melodies. But in young children and sound-producing animals there is no question of a system of stable intervals. Bird-song occasionally impresses musical people as though it consisted of musical themes made up of stable intervals. Closer observation will show, that bird-song is a mere sequence of sounds differing

in absolute pitch, but not dependent on tonal relations as in human beings¹¹⁾.

It is amazing how uncritically lovers of animals and even ornithologists assert that, e.g. the thrush prefers themes intervals of which coincide with those of a major triad, while other scientists assure us that gibbons sometimes sing a chromatic scale. (Ch. Darwin, A. Vogt).

The evolutionary primacy of tonal pitch or distance is also favoured by an assumption founded on folklore, namely that in the early stages of music and also at the first attempts to build up tone systems, tonal distances had a greater importance than interval-qualities. Among other things, the preference of primitive people for the sound of percussion instruments, differing in pitch, but lacking quality, points in that direction. The observations of Werner¹²⁾ provide an additional proof for the evolutionary primacy of distance. He discovered that, when observed in succession, two tones which show a slight difference in frequency, in the beginning would appear rather indefinite and vague whereas in the course of prolonged exercise they acquire stable qualities and thus produce the sensation of an interval¹³⁾.

This evolutionary conception also points to certain analogous conditions in the realm of optics. It appears that light and brightness are just as closely linked as tone and pitch, whereas hue and tonal-quality are less closely connected with the objective stimuli, and therefore they seem to belong to a later stage of evolution than brightness and pitch. An argument in favour of the priority of achromatic sensations in sensory evolution may

¹¹⁾ G. Révész, *Der Ursprung der Musik*. Intern. Archiv f. Ethnographie, 40, 1941, p. 65.

¹²⁾ H. Werner, *Einführung in die Entwicklungspsychologie*. 1933. p. 83.

¹³⁾ H. Werner's claim that in the present case micro-intervals arise which, like true intervals, are interpreted as fifths or octaves, is based upon a similar illusion as his other bold assertion, viz., that the intervals used in current musical practice do not depend on definite frequency relations, but that any relation may create the impression of any musical interval. When v. Hornbostel infers that in a "micro-melody" the frequency relations of the intervals remain unchanged and that a change occurs merely within the objective standard, his presentation and interpretation of Werner's experiments disagrees with the author's own description. (*Handb. d. Physik*. 8 p. 429.)

be found in the fact that chromatic and achromatic impressions are interrelated with two independently functioning sensory organs in the retina of which the cones, being more differentiated, are restricted to the central parts of the retina whereas the rods spread over the whole area of the retina. The different functioning of these two different nerve-organs on the one hand, the different types of daltonism on the other, favour the following genetic conception: — in evolution the achromatic sensations (brightness) form an earlier stage of vision than the chromatic ones. The latter may again be subdivided in an earlier bichromatic stage, preceded by a panchromatic period ¹⁴⁾.

I contend that the qualitative character being less firmly established on account of its late evolution, may be one of the reasons, why the same tonal quality is linked up with different pitches, thus showing a less rigid dependence upon the frequency of vibrations than the sensation of pitch. The same quality can, on the one hand, associate itself with the doubled number of vibrations in the octave tones, on the other — as it appears in paracusis — become the character of *every single tone* within the range of pitches. Also in this respect there are similar relations in the sphere of visual sensations. What, on principle, may be possible with tone-qualities is a common feature with hues. Every hue can appear in different grades of brightness.

When realizing the numerous analogies between vision and audition we should not be surprised that tones of different qualities would sometimes elicit intermediary quality sensations, just as colours do. Much the more so as fusion of tonal sensations can also be observed in normal persons. It is true that in this case the fusion is restricted to qualitatively *equal* sensations. The first example of such fusion we encounter on simultaneous sounding of notes with an *equal number* of vibrations, as e.g. two *c*¹ tones blending into a 1st (prime). The second is that of two notes being sounded at octave distance. Fusion within the octave is, however, imperfect, because the difference of pitch would never

¹⁴⁾ Parinaud, Comptes Rend. 99, 1881; v. Kries, Zeitschr. f. Psychol. 9. and 23. and Nagels' Handbuch der Physiol. III, 1905. Further: Ladd—Franklin, Colour and Colour Theories, Mind, 19. 1929; J. H. Parsons, The Theory of Perception, 1927.

allow a complete fusion. A perfect mixture results only when the component tones are of *equal pitch*. This is a condition which in the first place is fulfilled by the simultaneous sounding of identical notes, resulting in a 1st; in the second place when monaurally different perceptions of the same tone are binaurally combined to a *mixed sound*. From a theoretical point of view, and despite all the differences existing in their character as well as in the conditions of their being produced, the 1st and the mixed sound are kindred phenomena.

VI

Finally, there is the question whether the current *theories on hearing* enable us to explain the binaural mixture of sounds. To this question there is only a *negative answer*.

All the audition theories are in my opinion inadequate, in that they fail to account not merely for such a peculiar acoustic phenomenon as here described, but *for all kinds of tonal sensations*. They do not penetrate quite to the acoustic phenomena, but end just where the psycho-physiological processes begin and the acoustic and musical phenomena evolve.

We are far from underestimating the importance of the theories of hearing as to the function of the interior ear. It is merely intended to point out, that the current theories cannot be expected to supply a reasonable hypothesis to explain the acoustical phenomena. On realising that the theories of hearing restrict themselves to investigating the physical effects of sound vibrations on the ear, we recognize that the proper problems of psychological acoustics cannot possibly be solved by them.

All theories on hearing agree in their confinement to the physical-mechanical action of sound stimuli upon the middle inner ear (tympanum, tympanic bones, lymphatic fluid, basilar membrane). The fundamental theories on hearing, resonance and "stationary waves" are essentially physical and not physiological, still less psycho-physiological conceptions. They try to solve the problem how sound vibrations pass through the outer and middle to the inner ear, to the sound receptors of the cochlea, and what kind of mechanical action they produce inside the labyrinth. They deal essentially with the determination of the *kind of vibratory motion* which the sound stimulus imparts to

the basilar membrane and to the fluids in which this sound receptor is embedded ¹⁵⁾.

According to the resonance hypothesis of Helmholtz a selective sensitivity of the fibres of that membrane would act as a series of differently timed resonators, whose task it is to co-operate in the "mysterious" change of sound vibrations into tone perception ¹⁶⁾. According to the conception of stationary waves, devised by Ewald, the whole basilar membrane vibrates at the impact of a mechanical stimulus, thus being subdivided over its whole length into a series of stationary waves, or as the modified theories put it, into wave-ranges, or in progressive waves ¹⁷⁾.

The two theories interpret, and not unjustly, the basilar membrane as a vibrating system. To this purpose they attempt to investigate this anatomical representative of the acoustic receiver with regard to its physical structure relying on our conceptions of co-vibrating masses. The discussions of theorists also restrict themselves to the mechanical vibration-element within the sound receptor of the ear, notably sensitivity, elasticity, tension, damping, oscillatory capacity, kinds of vibration and functions peculiar to the substance and fabric of the membrane and to the medium surrounding it. In doing so no other considerations arise than those used in the physical examination of two-dimensional sounding producers.

This is the point where an erroneous conception comes in unperceived, promising more than it can hold. As soon as a somewhat plausible idea has been formed as to the propagation of sound in the inner ear and its action on the oscillating structures of the auditory apparatus, one believes one has found a reasonable solution, within the scope of possibilities, of all acoustical problems requiring explanation.

For everything that as yet cannot be explained by the physical theories of hearing — and that is the majority of questions — the central organ is made responsible, although its functions and mode of action are still little known to us.

¹⁵⁾ Compare: E. Meyer, *Gehör, Handbuch der Physik*, edited by Geiger & Scheele, VIII, 1927.

¹⁶⁾ H. v. Helmholtz, *Die Lehre von den Tonempfindungen*. 1913.

¹⁷⁾ J. R. Ewald *Pflügers Arch. f. d. ges. Physiol.* 76, 1899; 93, 1903; 131, 1910.

Among the theories of hearing, the resonance theory has at least this advantage that it can explain subjective sound analysis, though this has a mere secondary importance for psychological acoustics. But this theory completely fails to suggest anything reasonable as to chords of a monophonic or polyphonic nature. It is known that sound analysis is explained physically by hypothetical "resonators" within the ear, but the primary question of sound composition, the combination of tones, harmonic as well as symphonic, are accepted as facts requiring no further comment.

With the theory of stationary waves the matter is just the opposite: the given physical condition of the perception of a single tone or of a tone combination is seen in the vibration of the basilar membrane as a whole, in the so-called sound-pictures. The physical premise of a single tone or of a polyphony is well enough supplied by the conception of a complex oscillation, constituting a kind of oscillatory picture of the basilar membrane. But how to analyse within this soundpicture the small elements, as in a harmonized piece of music the melody, or when in a polyphonic composition the counterpointing individual voices are heard and pursued, that remains a puzzle, the solution of which, according to the common recipe, is left to the central organ.

That our current theories of hearing cease to explain things where psycho-physical and psychological problems begin to arise, is in my opinion the result of the fact that they take *physical processes* in the auditory organ as a starting point, instead of *acoustical phenomena*. Helmholtz has made the same mistake with his colour vision theory, when, starting from colour mixtures, he transferred the physical conditions to physiology (three-colour theory)¹⁸⁾.

In the field of optics it was Ewald Hering who radically changed the starting point by placing emphasis on the phenomenology instead of upon physics. He set about his work in the opposite direction as did Helmholtz when attempting to develop a physiological (photochemical) theory (four-colour theory), *starting with the colour phenomena* before coordinating them with the physical processes¹⁹⁾. Hering succeeded in establishing

¹⁸⁾ H. v. Helmholtz, *Handbuch der physiol. Optik*, 3rd Ed. 1910.

¹⁹⁾ E. Hering, *Grundzüge der Lehre vom Lichtsinn*. 1905—1911.

a comprehensive theory of colours, well founded in psychological and physiological respect. This theory has then been perfected by G. E. Müller into the theory of counter-colour²⁰⁾.

A similar recasting has not yet taken place in acoustics. Here the theories have failed to rise above the level of physics up to the present. So long as the (physical) theories of hearing are not amplified towards the psychological side, there will be no prospect for them to explain problems of sound psychology. It cannot even be asserted that one theory should have a greater value in the explanation of phenomena than the other. There are the resonance-theory of Helmholtz, and its modifications proposed by Wätzmann, Roaf, Fletcher²¹⁾, and there is the theory or stationary waves of Ewald and allied hypotheses of Hurst, Bonnier, ter Kuile, M. Meyer, v. Békéssy²²⁾.

From all these theories it seems impossible to move forward into the phenomenology of acoustics. These theories also fail to explain that type of binaural hearing with the binaural mixture of sound qualities, which is the subject of this paper. And much the more so because, according to all these conceptions, a single objective tone is only able to produce one specific reaction in the receptive apparatus of the inner ear, thus leaving splits in the sensation quite unintelligible and unexplained. In this connection it seems quite irrelevant, whether it is supposed that the cochlea contains a system of turned resonators, or contended that resonance would occur by movements of the lymphatic fluids. It is also immaterial whether the whole basilar membrane is considered as an oscillator in which the influence of sound stimuli produce static or progressive vibrations. So long as it is maintained that all the acoustic phenomena can be understood on

²⁰⁾ G. E. Müller, *Zur Psychophysik der Gesichtsempfindungen*, Z. f. Psychologie, 10 & 14.

²¹⁾ E. Wätzmann, *Die Resonanztheorie des Hörens*, 1912, and *Handb. d. Physiologie*, Bethe, XI, 1926; H. E. Roaf, *Phil. Mag.* 43, p. 349, 1922; H. Fletcher, *Journ. Franklin Inst.*, 1923, p. 312.

²²⁾ C. H. Hurst, *Proc. Transact. of the Liverpool biol. Soc.*, 9, 321, 1894/5; E. Bonnier, *Bull. Scient. de la France et de la Belgique*, 25, p. 367, 1893; E. ter Kuile, *Pflügers' Arch. f. d. ges. Physiol.* 79, p. 484, 1900; M. Meyer, *Ibid.* 78, 81 and 153, 1899—1913, and *Univ. Missouri Stud. Sci. Serv.* 1907; G. v. Békéssy, *Physikalische Z.schr.* 29, p. 793, 1928 and 30, p. 115, 1929; J. Bijtel, *Kgl. Nederl. Akademie v. Wetenschappen*, Amsterdam, 44, pp. 198 and 1037, 1941.

the physical basis, viewing the peripheral apparatus of hearing, one cannot penetrate into the phenomena of pitch, quality of tone, distance, interval, to the disunion of tonal qualities and to sound mixture, not to mention the remaining fundamental sound sensations, such as octave sensation, consonance, accord, etc. In view of these phenomena, remarkable both for hearing and for psychological and musical acoustics, we are for the time being obliged to restrict ourselves to the observation and examination of tonal sensation and to leave their theoretical consideration to sound psychology.

SUMMARY

Similar to *binocular colour mixture*, there also exists a *binaural sound mixture*, demonstrable first in cases of paracousis, and also in persons with "normal" hearing. The binaural mixed tone lies between the two monaural tonal qualities, just as the binocular mixed colour is found between the two colours that are mixed. More exactly, the position of the binaural tone depends on the intensity of the monaural components, just as the intermediary binocular colour depends on the intensity of the separate monocular colours. A simple formula expresses the rules of binaural mixture: Equal intensity of sensation being presupposed in both ears, the corresponding vibration number of the binaural tone being the average between the monaural frequencies. No such general rule of mixture exists for binocular colour mixtures.

In order to obtain a sound mixture, either two tones of equal pitch and quality are needed (1st), or two tones of equal pitch but unequal quality (binaural mixture), the latter case being realizable only in binaural hearing. Colour mixtures can be produced by all possible shades; but binocular mixture, in analogy with binaural sound mixtures, is most easy to obtain with colours of equal or almost equal brightness and of identical or almost identical quality as well as with qualitatively different colours of the same brightness.

Binaural sound mixtures can be understood on the basis of the dualistic theory of sound perception. Tone mixture is incomprehensible without a splitting of a compound tone sensation into pitch and quality. None of the single-component-theories can characterize the phenomenological content of monaural and binaural sound perceptions, or explain them properly. Physical sound theories whose sphere of validity does not go beyond the physics of peripheral sound organs can, on principle, neither supply view points for the explanation of these phenomena, nor for the other acoustical and musical fundamentals.

The discovery of the phenomena of sound-mixture and their far-reaching accordance with colour-mixture has done away with one of the major difficulties that opposed the formation of a general sensory-physiological theory comprising the two higher senses.

ZUSAMMENFASSUNG

Analog der *binokularen Farbenmischung* gibt es auch eine *binaurale Tonmischung*, die in erster Linie im Zustand des Falschhörens, unter Umständen auch bei Normalhörenden unzweideutig nachzuweisen ist. Der binaurale Mischton liegt zwischen den beiden monauralen Tonqualitäten, wie die binokulare Mischfarbe zwischen den beiden zu mischenden Farben. Die genaue Stelle des binauralen Tones hängt wiederum, wie die der binokularen Farbe, von dem Intensitätsverhältnis der monauralen Töne bzw. monokularen Farben ab. Das binaurale Mischungsgesetz lässt sich in sehr einfache Weise formulieren: Bei gleicher Empfindungsstärke des rechten und linken Tones ist die korrespondierende Schwingungszahl des binauralen Mischtones das Mittel der korrespondierenden Schwingungszahlen der monauralen Töne. Ein so allgemein geltendes Mischungsgesetz für die binokulare Farbenmischung gibt es nicht.

Für das Entstehen der Tonmischung sind entweder zwei höhen- und qualitätsgleiche Töne (Prime) oder zwei höhengleiche aber qualitätsungleiche Toneindrücke (binaurale Tonmischung) erforderlich, wieweil letztere nur bei binauralem Hören möglich ist. Farbenmischung lässt sich mit allen Farbtönen herstellen; binokulare Mischung erfolgt jedoch in Uebereinstimmung mit der binauralen Tonmischung am leichtesten mit gleich oder nahezu gleich hellen Farben von gleicher oder nahezu gleicher Farbenqualität, ferner mit verschiedenen Farbenqualitäten bei gleicher Helligkeit.

Die binaurale Tonmischung lässt sich nur durch die Zweikomponentenlehre begreiflich machen. Ohne die Spaltung des einheitlichen Toneindrucks in Tonhöhe und Tonqualität ist die Tonmischung unfassbar. Die Einkomponentenlehren sind nicht imstande den phänomenalen Inhalt der monauralen und binauralen Toneindrücke auch nur annähernd zu charakterisieren, geschweige denn dafür Erklärung zu geben.

Die physikalischen Hörtheorien, deren Geltungsgebiet nicht über die physikalischen Vorgänge im peripheren Gehörorgan reicht, können prinzipiell weder Gesichtspunkte für die Erklärung dieser Erscheinungen noch für die anderen akustischen und musikalischen Grunderscheinungen geben.

Durch Feststellung der akustischen Mischungsphänomene und ihre weitreichende Uebereinstimmung mit den Farbenmischerscheinungen ist eine der grössten Schwierigkeiten, die bei der Aufstellung einer allgemeinen, die beiden höheren Sinne umfassenden sinnesphysiologischen Theorie entgegentritt, beseitigt.

LE MECANISME DE L'INFLUENCE DES MOUVEMENTS DE LA TETE SUR LA LOCALISATION DES SONS

par

A. GEMELLI M.O.

Depuis longtemps, comme on sait, on discute sur la localisation des sons. On défend trois théories, qui portent, comme facteur déterminant de la localisation, les différences de modalité des stimulations qui arrivent aux deux oreilles de la source sonore commune: c'est à dire, respectivement: 1°) la différence de temps; 2°) la différence d'intensité; 3°) la différence de phase. En faveur de chacune de ces théories se sont rangés de nombreux physiologues et psychologues avec différentes expériences, et contre chacune d'entre elles on a élevé de nombreuses objections et l'impossibilité de donner la raison de tous les faits.

Il y a même ceux qui ont cherché comme l'ont fait tout récemment Stevens et Davis ¹⁾ à concilier ces différentes théories en montrant que dans la localisation des sons à basse fréquence, c'est surtout le facteur „différence de phase” qui intervient, tandis que dans la localisation des sons à haute fréquence c'est la différence d'intensité qui entre en jeu.

Toutefois aucune de ces trois théories n'a réussi, malgré les affirmations contraires, avancées par quelques uns, à gagner le consentement.

Pour s'orienter dans l'étude de ce problème, et pour bien poser l'examen expérimental du problème même, de façons à pouvoir atteindre une conclusion positive, à mon avis, on doit faire quelques prémisses.

1°) Dans tous les cas cités dans lesquels la différence modale de la stimulation est considérée comme la cause de la localisation du son dans l'espace, plutôt que d'une véritable localisation des sons, on devrait parler de latéralisation des sons, c'est à dire,

¹⁾ *Hearing*, 1938, pag. 179.

de la détermination de l'angle latéral entre la direction d'un son déterminé et l'axe des oreilles. En outre il faut remarquer que les facteurs susdits de latéralisation d'un son pourraient être avancés pour déterminer la localisation d'un son, dont la direction se trouve sur le plan horizontal coïncidant avec l'axe des oreilles, mais non pas pour ces sons, dont l'origine est au dehors de ce plan. Dans ces dernier cas on a une telle variété de localisations, que Alves Wilsha ²⁾ est arrivé à affirmer que, si la tête de celui qui entend est immobile (perception acoustique statique) la perception est „astigmatique” dans le sens que l'ensemble des directions possibles et équivalentes d'un son, forment une surface conique (plus exactement une hyperboloïde) et le sujet n'a pas le moyen de choisir les sons correspondants à la localisation réelle entre les différentes directions équivalentes possibles, si un autre facteur discriminatif n'entre en jeu.

2°) A mon avis, ce problème est insoluble, tant qu'on se borne à déterminer la direction d'un son en s'appuyant sur l'étude des caractères avec lesquels se présente à nous la sensation acoustique correspondante à un son qui arrive aux deux oreilles par une source sonore déterminée, c'est à dire dans les différentes modalités de cette sensation acoustique bilatérale. En posant le problème de cette façon, on considère la localisation acoustique comme une donnée sensorielle primitive, c'est à dire, comme une *qualité* de la sensation acoustique. Au fond, on peut bien dire que les défenseurs de toutes les trois théories ont raison, parce que la stimulation acoustique qui atteint les deux oreilles, les atteint, selon les cas, avec l'une ou l'autre des trois „qualités caractéristiques”.

3°) On peut donner à ce problème une solution adéquate, seulement quand on considère que la donnée sensorielle acoustique, vrai „message sensoriel” dans le sens de H. Piéron, fait partie d'un organisme complexe de caractère sensoriel; à savoir d'une perception à laquelle on attribue, comme signification, l'évaluation de la localisation. Dans un mot je pense que la localisation d'un son est possible seulement grâce à un procédé complexe dont la donnée sensorielle est le fait primitif qui est élaboré et intégré par d'autres données; au produit (la percep-

²⁾ „Acta Societatis Medicorum Fenniae”, „Duodecim”, S.A. t. XXI, f. 1. I; 1938.

tion) on attribue la valeur d'une détermination ou jugement élémentaire (en haut, à droite, derrière, devant, au loin, tout près, etc.) On ne doit pas donc parler de localisation d'un son comme d'une „qualité” sensorielle, mais plutôt comme un procédé perceptif dont le résultat est la détermination de la source de la stimulation acoustique.

4°) Cette façon d'envisager le problème permet de nous placés sur une base positive et d'arriver à une solution acceptable du problème; cela est bien montré par le fait que, tout au contraire de ce qui arrive dans les expériences exécutées dans une chambre acoustique, on n'a jamais dans la vie commune une localisation statique, mais une localisation cinétique; c'est à dire, dans la localisation d'un son dans la réalité de la vie, entrent en jeu trois autres groupes de données sensorielles: a) les stimulations proprioceptives des muscles auxquels on doit les mouvements de la tête: b) les stimulations visives; c) les stimulations de l'apparat vestibulaire. Evidemment toutes ces données sensorielles n'entrent pas toujours en jeu; la nuit, on n'aura pas les données visives; si un sujet est obligé à tenir la tête immobile, on n'aura pas les stimulations musculaires proprioceptives: si un sujet tourne lentement et de façon uniforme sur une chaise rotative, on n'aura pas les stimulations du labyrinthe; à cause de cela dans tous ces cas, qui peuvent être réalisés expérimentalement pour déterminer l'action covariante de chaque facteur, la localisation peut être moins précise, moins sûre et même on peut avoir des erreurs. Néanmoins une localisation de la direction des sons, fondée sur les seules données acoustiques a lieu seulement dans la localisation statique, qui ne se vérifie pas dans la vie, dans laquelle au contraire la localisation est cinétique, c'est à dire accompagnée des mouvements de la tête et même du corps, ce qui permet de choisir entre les directions possibles et équivalentes, celle qui correspond à la réalité. Par exemple, si un son est émis dans une direction qui se trouve dans le plan horizontal des deux oreilles, le son atteint les oreilles en formant un angle avec l'axe des deux oreilles, de sorte qu'il y a une différence de temps ou de phase ou d'intensité, le sujet sait dire avec une exactitude suffisante quel est le degré de latéralisation de la source sonore, mais il ne sait pas dire si elle c'est en face de lui ou derrière lui.

Pour choisir entre ces deux possibilités, comme je l'ai déjà montré, un autre élément est nécessaire. Evidemment cette ambigüité n'existe pas, si la source sonore est perpendiculaire à la tête: au contraire, elle se vérifie si la direction du son est oblique, et se trouve dans un plan à une distance angulaire déterminée du plan horizontal. Déjà, tout dernièrement Alvas Wilsha, cité plus haut, ainsi que Hans Wallach³⁾ ont montré, avec plus de précision qu'on ne l'avait fait auparavant, que les mouvements de la tête ont pour fonction de servir à la discrimination localisatrice des sons. Mais les recherches de ces auteurs, quoique intéressantes n'ont certes pas épuisé le problème, parce qu'il était nécessaire de montrer le mécanisme du facteur cinétique.

Ces considérations sont les prémisses des recherches que j'ai exécutées et dont j'expose sommairement les résultats obtenus, tandis que la description de la technique employée, l'analyse des résultats obtenus, ainsi que leur élaboration seront l'objet d'une ultérieure relation précise, ample et documentée.

Les expériences exécutées en partant de ces prémisses sont les suivantes:

1°) J'ai exécutée un premier groupe de recherches en mettant le sujet sur un chaise rotatif, mue par une rotation uniforme et très lente; le sujet pouvait ainsi écouter successivement le son dans les différentes positions relatives; donc, avec l'avantage de pouvoir se servir de la discrimination que l'on a dans la perception cinétique, mais avec l'exclusion de l'influence des stimulation proprioceptives dues aux mouvements musculaires et des stimulations labyrinthiques dues à l'accélération.

2°) J'ai exécuté un second groupe de recherches en faisant rouler autour du sujet un cylindre de toile à bandes noires, de façon à provoquer dans le sujet la perception d'un mouvement apparent de son propre corps. En changeant la vélocité du cylindre j'arrivais à ce que le sujet eût la perception d'un mouvement apparent (en sens contraire au mouvement réel du cylindre) du milieu, tandis que le sujet avait la perception que son corps gardait la même place.

Dans d'autres expériences, dans le sujet je provoquais la perception d'un mouvement apparent du milieu, qui dans la ro-

³⁾ „Psycholog. Forsch.", B. XXII, H 3, 4, 1938; „J.A.S.A.", Vol. 10, april 1939; „Journ. exp. Psych." Vol. XXVII, N. 4, ott. 1940.

tation précédait celui, apparent aussi, de son corps et qui était dans le même direction de ce dernier.

3°) J'ai exécuté des recherches en supprimant seulement la donnée visuelle.

4°) J'ai exécuté enfin des recherches en faisant tenir au sujet la tête différemment inclinée sur son tronc, en maintenant la tête immobile dans la position voulue grâce à un dispositif adapté.

Ces différentes conditions expérimentales m'ont donné le moyen d'étudier l'influence des différents facteurs; c'est à dire de stimuler les deux oreilles; toutefois, tandis que la stimulation présentait successivement les trois modalités: a) différence de temps; b) différence d'intensité; c) différence de phase, la position de la tête aussi pouvait varier. De cette façon on présentait au sujet successivement des stimulations dans les directions possibles et équivalentes, en faisant varier la position dans l'espace (relativement au sujet) de la source sonore; en même temps je faisais agir ensemble ces différents facteurs cinétiques qui servent au choix des directions possibles et équivalentes.

Les stimulations acoustique employées ont été différentes; de simples cliks indiquant l'interruption ou la fermeture d'un circuit, des rumeurs d'intensité différente, des sons de fréquence variée des logatons, des accords musicaux.

La position de la source sonore par rapport au sujet a été variée grâce à un moyen déjà employé par d'autres studieux qui se sont occupés du problème de la localisation acoustique, c'est à dire, en plaçant la tête du sujet au centre d'une cage métallique qui dans des points prédéterminés avait de hautparleurs, chacun desquels pouvait être mis en mouvement par l'expérimentateur selon un plan prédéterminé.

Dans quelques expériences on a enregistré les mouvements de la tête; le moyen employé peut être indiqué sommairement de la façon suivante: on a placé sur la tête du sujet un casque qui portait trois plumes écrivantes qui permettaient l'enregistrement des mouvements possibles dans les coordonnées de l'espace; par exemple une plume correspondait au sommet de la tête; une autre correspondait à la région frontale, une autre à la région temporale ou bien à la mandibule.

Les résultats obtenus peuvent être sommairement résumés dans les conclusions suivantes:

1. J'ai réussi à varier les conditions de la genèse d'une perception acoustique localisatrice, en faisant disparaître l'un ou l'autre des facteurs auxquels on doit la localisation de la source sonore; l'absence d'un des facteurs est révélée par le nombre et la qualité des erreurs, c'est à dire dans le sens et le degré des déviations dans la localisation.

Le facteur principal dans la localisation des sons, dans les expériences susdites, n'est pas donné par un simple mouvement de la tête, mais par une suite de mouvements; ceux-ci se présentent dans une succession, dans laquelle ils deviennent toujours moins amples et toujours plus rapides: ces mouvements sont involontaires; ils cessent avec la détermination de la localisation de la source sonore.

La localisation suit dans son procédé général d'élaboration cette suite de mouvements.

2. Si le sujet est placé dans la condition de percevoir un mouvement apparent de son corps, alors la localisation acoustique suit ce mouvement subjectif et est liée à lui.

3) Dans chaque cas le sujet rapporte la localisation du son, non pas à ses organes de l'ouïe, mais au schéma de son corps; le schéma corporel guide la localisation, comme je l'ai déjà montré avec d'autres recherches, par la perception de la position relative des parties du corps.

4. La localisation d'un son n'est donc pas une donnée sensorielle, une qualité de la sensation, mais elle est le produit d'un procédé complexe dans lequel les mouvements de la tête ont une grande valeur, parce qu'ils permettent au sujet de choisir entre les directions possibles et équivalentes, qui lui sont présentées grâce à la différence d'intensité, de temps ou de phase; l'élément directif est le schéma du corps auquel le sujet rapporte la localisation relative de la source sonore dans l'espace, comme le démontrent le degré et le sens des „erreurs” de localisation que l'on a pendant les mouvements apparents ou de son corps ou du milieu.

Les mouvements de la tête ne peuvent donc, par eux-mêmes, suffire à la localisation cinétique du son, si un facteur psychologique directif, tel que le schéma corporel auquel se rapporte toute donnée acoustique, n'intervient pas.

4) „Rivista di medicina Aeronautica”, marzo 1940.

THE MANDIBLE PRINCIPE IN MUSCULAR ACTION

D. KATZ (STOCKHOLM)

and ROBERT B. MAC LEOD (SWARTHMORE, PA.)

In a recently published investigation, D. Katz¹⁾ pointed out that two phenomenologically quite different types of perceptual experiences may result from the excitation of receptors in muscle, tendon, joint, and skin; when the implicit reference is to ones own body, for instance in the perception of the weight of ones body, the experience is by no means the same as when it bears reference to externally performed work. This difference, moreover, is not merely a characteristic of the perceptual complexes which emerge under such conditions, but is surprisingly evident in any quantitative judgement as to the relative amounts of effort involved in the two types of experience. Under conditions of equal output of physical energy, work which bears an external reference appears much greater than work which is performed in the service of ones own body. In many cases this "error" of estimation reaches enormous proportions. To quote one of many possible examples, a pull of 10 kg., produced when the arms are supporting the body in an upright position by means of a wooden standard, appears equal to the pull of a free weight of 3 kg. Thus the pull of the free weight is overestimated in a ratio of more than 3 to 1 in comparison with the pull on the standard. Striking errors of estimation have also been found by Katz and Stevenson²⁾ in the comparison of the pull of an elastic body, e.g. a rubber band, with that of a freely moving weight. Many subjects guessed the dead weight to be twice as heavy as a physical equally heavy elastic weight.

The following report deals with a new series of phenomena, which are also based on the functioning of the muscle, tendon,

¹⁾ D. Katz, (a) *Die Wahrnehmung des eigenen Körpergewichts*. 11. Congrès international de psychologie. Paris. 1938.

(b) *Die Wahrnehmung des eigenen Körpergewichts Festschrift für Anathon Aall*. Oslo, 1938.

²⁾ D. Katz and W. Stephenson. *Experiments on elasticity*. British Journal of Psychology, vol. 28, 1937.

joint and skin senses but which, both on phenomenological and experimental grounds, must be placed in a special category. We are justified in assuming that the allied motor processes are likewise to be accorded a special position. These phenomena are to be observed when two parts of the body are functionally opposed to each other in such a way that they operate after the fashion of pincers or mandibles. When the hand grasps an implement the thumb and opposed fingers function in this way. Similarly, when we eat, the two jaws work in opposition to each other, subserving not only the function of holding the food, but also that of masticating it. In the infant, the function of the jaws is to hold rather than to chew. The jaws hold on to the nipple, while the sucking activity proper is accomplished by means of other organs, principally the tongue. An older child, who has already come to use his jaws for the purpose of chewing, occasionally reverts to the mandible function when he wishes to hold something and finds his hands already occupied. This is particularly noticeable, for instance, when a hand has been rendered temporarily useless through injury³). Even when one hand is artificially excluded from action, a child may easily rediscover the use of the jaws as an accessory hand for purposes of grasping⁴). Occasionally adults who have lost both hands make use of the mandible function of the jaws for operation of instruments; and among animals, such as dogs, which use the mouth for holding and carrying heavy objects as well as for eating, this function is particularly recognizable. The phenomena which we are here reporting may be observed also in the cooperative action of the two hands, and even of the two knees, when something is being held between them, although here they are not as evident as in the functioning of the jaws or of the single hand. In referring to these phenomena we shall speak of the *mandible principle* in muscular action.

When we grasp a heavy implement, such as an axe, and make various movements with it, we can always distinguish clearly between the weight of the axe and the impression produced by

³) David u. Rosa Katz, Das Verhalten eines Kindes bei Behinderung eines Armes. Zeitschrift für Psychology, Bd. 99, 1926.

⁴) Rosa Katz, Über motorische und geistige Umstellung bei Ausschaltung normaler Lösungsmethoden von Aufgaben. 11. Congrès international de Psychologie. Paris, 1938.

our grip on the axe-handle. Whereas our judgment of the weight of the axe is fairly accurate, however, it is exceedingly difficult for us to estimate the amount of work involved in the act of grasping. This seems to be closely bound up with the fact that the weight of the axe is objectified, i.e., apprehended as something distinct from ourselves, whereas the pressure which we exert upon the handle is not. It is apprehended, rather, as a state of our body, or, more precisely, of our hand. It was found by Fischel that in the lifting of weights very clear constancy phenomena may be observed⁵). Fischel demonstrated that it makes very little difference in the estimation of a weight whether the weight is lifted in ordinary fashion with the whole arm or lifted merely with the hand, or even with the teeth, the foot, or by means of a strap attached to the head. The accuracy with which weights can be judged under such widely varied conditions suggests that it cannot be primarily a product of learning; for, if so, methods of lifting such as these, which are hardly ever employed in everyday life could not be expected to give such good results. A necessary precondition of all constancy phenomena in the lifting of weights is our ability to apprehend weight as an intrinsic property of objects as such. The pressure which we exert on an implement when we grasp it does not constitute a property of the implement, but is apprehended as depending entirely upon ourselves. We might consequently predict, not only that this type of experience could not give rise to constancy phenomena, but that our estimates of such pressures should belong to an entirely different order of magnitude. This expectation is clearly confirmed by the following experiments.

Let us begin with some measures of the mandible phenomena by means of an ordinary dynamometer. The customary procedure with such an instrument is, of course, to grip it with one edge at the base of the thumb and the other against the opposing fingers. The subjects were instructed to lift a weight with one hand, and immediately thereafter to squeeze the dynamometer with the same hand with the same degree of effort as had been used in lifting the weight. Such a task is, of course, by no means

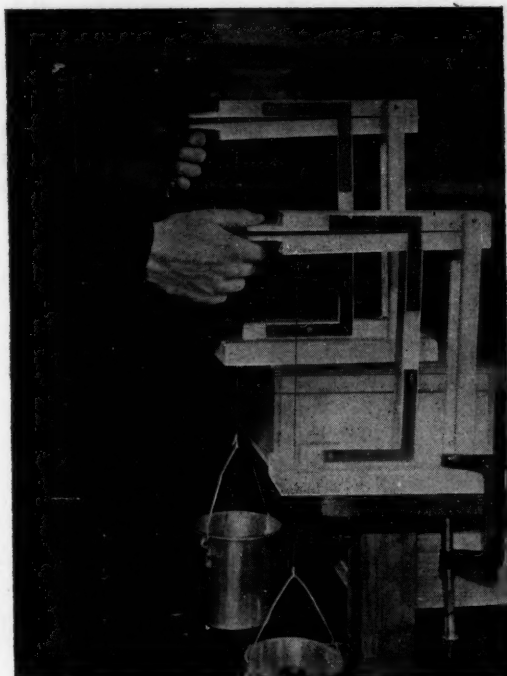
5) H. Fischel, Transformationserscheinungen bei Gewichtshebungen. Zeitschrift für Psychologie, Bd. 98, 1926.

simple. It is significant, nevertheless, that no subject rejected it as meaningless or impossible, and only one or two reported it as difficult. The specific task was to lift two weights, of 2 kg. and 5 kg. respectively, and to equate in terms of pressure on the dynamometer. The results for 8 subjects may be summarized as follows: The 2 kg. weight was equated to dynamometric values ranging from a minimum of 17 kg. to a maximum of 45 kg., and the 5 kg. weight was from 24 kg. to 63 kg. Thus the error of estimation, expressed in terms of an approximate ratio, corresponds in the first case to a range of from 1 : 8 to 1 : 22, in the second case to a range of from 1 : 4 to 1 : 12. Such underestimates seemed at first to be so unbelievably large as to suggest that the subjects were not taking their tasks seriously. When we repeated the observations ourselves, however, — i.e., with full knowledge of the tendency to underestimate the dynamometric pressure — we obtained strictly comparable results. When one looks at the dynamometer scale, and at the same time exerts a moderate pressure of, say, not more than 10 kg., one is astonished to find that such a pressure is scarcely perceived at all.

Further experiments were conducted with a small apparatus which can best be understood from the accompanying photographs. Two wooden bars, 30 cm. in length, were attached together at one end by a hinge in such a way that one was rigidly fixed and the other could move through an angle of a few degrees with reference to it. In the basic experiments the upper bar was rigid and the lower bar movable, although control experiments were performed with the relationship reversed. At the movable end the bars were whittled down so as to have a thickness of only 0,5 cm., and the distance between them was never more than 0,8 cm. The ends of the two bars could thus comfortably be gripped between the teeth of two jaws or between thumb and index finger of one hand, and by a biting or pincer movement a weight could thus be lifted. At a distance of 1,6 cm. from the end of the movable bar was placed a hook from which a variable weight could be hung. Several pieces of apparatus such as this were used in the experiments.

In a first series of experiments two weights were compared according to the method illustrated in photograph I, except that the same hand was always used and that the comparisons were made successively. One weight was lifted, according to the

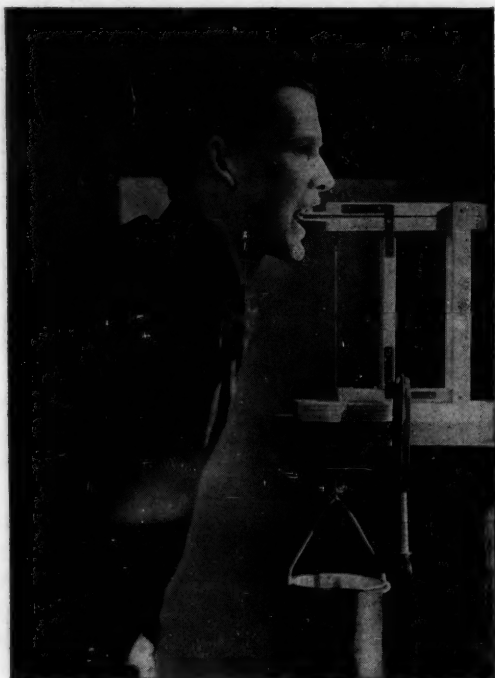
methods customary in weight-lifting experiments, by means of the forearm. In this case the index finger was placed beneath the lower (movable) bar and the pressure exerted in an upward



direction. The second weight was also lifted by means of the index finger, but this time the thumb was placed on top of the upper bar, and a pincer movement of the finger and the thumb thereby rendered possible. It is of no significance for the results that the point of suspension of the weight did not coincide with the application of the lifting force, since the relationship between these two points remains constant throughout. — In a second series of experiments a comparison was made between weights lifted by means of a biting movement of the jaws, as illustrated in photograph II.

The production method was used throughout. Since the ex-

periments were preliminary in character, and we consequently were not interested in exact measurements, the following quantitative values are to be taken merely as indicating general



directions. The weights used in the first series ranged from 1140 g. to 8250 g. Five subjects were used, and all showed a striking underestimation of the weights lifted by means of the pincer movement. For instance, with the heaviest weight, 8250 g., used as a standard, and lifting by means of the pincer movement, the equations made in terms of the conventional method ranged from 4007 g. to 5250 g. Similarly, the smallest weight, 1140 g., gave corresponding equations ranging from 640 g. to 750 g. Thus the effect of the mandible principle is to cause us to underestimate weights significantly in comparison with our ordinary perception of the same weights. The amount of underestimation varies in

our experiments from 36 % to 51 % in the heaviest weights, and from 34 % to 44 % in the lightest weights. The differences are even more striking when the jaws are used instead of the fingers and the thumb. In a direct comparison of weights lifted by means of these two types of mandibular movements, we found that a weight of 6040 g. lifted by the jaws was equated to weights lifted by finger and thumb ranging from 4110 g. to 4860 g., i.e., an underestimation of from 20 % to 32 %.

The present report can do no more than call attention to the foregoing observations. The underlying theory of the mandible phenomena must await further and more exact experiments.

SUR LA NATURE DES FACTEURS D'INTELLIGENCE ¹⁾

par

R. MEILI (BERNE)

L'existence de facteurs autre que le facteur „g” et les facteurs spécifiques est aujourd'hui presque généralement admise. Je ne sais pas si on est partout conscient de l'importance considérable de ce fait. Si Spearman a si longtemps nié l'existence de facteurs de groupe et a essayé de maintenir sa théorie des deux facteurs malgré les cas de plus en plus nombreux où le critère de la tétrade n'était pas satisfait, ce n'était certainement pas par pure conservatisme, mais parce qu'il savait, que l'introduction de ces facteurs de groupe appelait une interprétation psychologique et que par cela l'objectivité absolue qu'il recherchait était de nouveau perdue. Dans la théorie originale des deux facteurs le facteur „g” est défini par son caractère de généralité. Puisqu'il est le seul facteur pouvant se rencontrer dans plusieurs tests n'importe quel facteur non-spécifique devient par définition ce facteur „g”. Les facteurs spécifiques, d'autre part, étant définis chacun par le test dans lequel il se trouve, il n'est pas nécessaire de le caractériser psychologiquement. Avec l'admission d'autres facteurs généraux ou de facteurs de groupe la situation a complètement changé. Ces facteurs supplémentaires doivent être définis psychologiquement si l'on veut les distinguer les uns des autres. Comment voudrait-on savoir de quel facteur de groupe, entre plusieurs, on parle si on ne leur attribue pas quelques qualités spécifiques? Il ne suffira en effet pas de les définir par la simple énumération des tests dans lesquels on les rencontre. Car je peux trouver aujourd'hui un facteur commun aux tests A, B, C, demain un dans les tests D, E et F et plus tard encore un commun à ces six tests. Si l'on définit les facteurs de groupe seulement par l'énumération des tests on aura alors trois facteurs diffé-

¹⁾ Ce travail a été rédigé à un moment où, par suite de la guerre, les publications anglaises et américaines ne m'étaient pas accessibles. Néanmoins, d'après les rapports que j'en ai eus depuis, l'étude suivante ne paraît pas dépassée.

rents. Mais il se pourrait très bien, qu'en réalité, deux de ces facteurs ou même les trois soient identiques.

Le travail du psychologue n'est donc pas terminé avec l'analyse statistique des corrélations, il doit encore trouver une signification psychologique aux facteurs trouvés. Or, jusqu'ici les „facteuristes” ne paraissent pas aimer cette partie de leur travail et semblent presque devoir s'excuser de s'y risquer. Aussi s'en débarrassent-ils généralement le plus rapidement possible et se contentent-ils de désigner les facteurs par les qualités les plus extérieures des tests dans lesquels on les rencontre. Ainsi on fait actuellement le plus souvent mention d'un facteur verbal, d'un facteur numérique et d'un facteur spatial ou visuel.

Cette façon de caractériser les facteurs peut avoir deux significations différentes:

1) que le facteur en question est nécessairement présent dans tout problème qui possède la qualité caractéristique; chaque problème d'ordre verbal par ex. contiendra le facteur verbal. Dans ce cas il suffira donc de regarder l'aspect extérieur d'un problème pour savoir si tel ou tel facteur s'y trouve.

2) que le facteur en question se trouve seulement dans les problèmes possédant la qualité caractéristique mais pas dans tous. On rencontrera le facteur verbal par ex. seulement dans *certain*s problèmes verbaux.

Je ne vois pas que dans les travaux respectifs on ait nettement indiqué de laquelle des deux manières on associe le facteur aux qualités des problèmes. Et ce serait pourtant très nécessaire. Si l'on parle de facteur verbal etc., tout court, on semble admettre une correspondance complète. Dans ce cas, il faut pouvoir démontrer que le facteur est *toujours* présent dans les tests de nature correspondante. Si, par contre, la qualité du test n'est qu'une condition nécessaire mais pas suffisante de l'existence d'un certain facteur il faut indiquer les autres conditions nécessaires également c.à.d. il faut désigner le facteur autrement que par cette seule qualité verbale, numérique etc.

Nous allons voir en examinant un certain nombre de travaux relatifs à ces facteurs que la première manière de les interpréter est à exclure mais qu'on n'a jusqu'ici fait aucun effort pour en donner une signification plus exacte.

Le facteur verbal

La première recherche sur ce facteur a été faite, à ma connaissance, par Davey¹⁾. L'auteur a essayé de construire des tests non-verbaux — il les appelle „pictorial” — correspondant aussi exactement que possible à des tests verbaux afin de pouvoir être sûr qu'une différence éventuelle entre les tests puisse être attribué à ces caractères verbal et pictural.

Il y a donc dans la série de Davey deux tests de classification, deux tests d'analogies, deux où il faut mettre des mots resp. des images en ordre, deux tests de lacunes (dans les deux on lit à l'enfant un texte où il doit compléter les lacunes en choisissant un mot ou une image parmi quatre qu'on propose); dans une cinquième couple de tests il faut répondre à des questions posées verbalement en choisissant un mot ou une image; dans la sixième couple l'enfant doit écrire aussi rapidement que possible „tout ce qu'on peut voir” dans une image donnée (la forme verbale de ce test n'est pas décrite). On voit que les trois derniers problèmes picturaux comportent tous également une composante verbale ce qui peut expliquer les résultats peu clairs de cette recherche. Deux tests verbaux qui n'ont pas de pendant sur le plan visuel complètent la série. Il s'agit de tests de synonymes et d'identiques-opposés qui font appel à des connaissances précises du vocabulaire.

D'après l'étude des tétrades qu'on peut calculer avec les corrélations entre ces tests Davey conclut que dans quatre tests seulement sur huit (dans Identique-Opposé, Synonymes, Classifications et Questions) se rencontre un facteur de groupe. Sa nature n'est pas précisée, mais il ne peut pas s'agir d'un facteur verbal général, puisqu'il ne se trouve pas dans tous les tests d'ordre verbal.

Stephenson²⁾ dans des expériences très étendues, aboutit à une conclusion opposée à celle de Davey. Il se base sur huit tests non-verbaux et huit tests verbaux appliqués collectivement à 1037 enfants. Voici de brèves indications sur les tests employés.

a. Tests non-verbaux:

1. Former des lettres imprimées en capitales en utilisant d'autres lettres dont il faut supprimer une partie.

¹⁾ Davey, C. M. *Comparison of Group Verbal and Pictorial Tests of Intelligence*. Br. J. Psychol. 1926/27 XVII.

²⁾ Stephenson, W. *Tetrad-differences for non-verbal subtests*. J. educ. psychol. 1931, 22, p. 167.

Tetrad-differences for verbal subtests. Id. p. 255.

Tetrad-differences for verbal subtests relative to non-verbal subtests. Id. p. 334.

2. Test de substitution: inscrire au-dessous de certains signes des chiffres selon un code donné.
 3. Puzzle: indiquer par des traits de quelle façon une figure donnée se laisse décomposer en trois parties données.
 4. Lacunes d'images: indiquer la partie qui manque.
 5. Test d'analogies avec des figures géométriques: la quatrième figure est à choisir parmi quatre figures données.
 6. Test des cubes de Yerkes: compter le nombre de cubes dont est formé un tas.
 7. Séries à continuer: par exemple XXOXXOXXO.
 8. Des figures géométriques qui se couvrent partiellement sont données. Indiquer dans lesquelles de ces figures se trouve un certain numéro.
- b. Tests verbaux:
1. Un mot est donné; indiquer un synonyme.
 2. Indiquer dans une phrase le mot qui manque.
 3. Chercher parmi quatre mots celui qui appartient à la même classe que trois autres mots donnés.
 4. Dans une phrase, deux mots sont interchangés; les souligner.
 5. Indiquer, parmi quatre mots, deux mots opposés.
 6. Analogies: mot à choisir parmi quatre autres mots donnés.
 7. Parmi quatre mots, en choisir deux pouvant compléter des phrases du type: „Un homme a toujours...." (corps et tête).
 8. Exécuter des consignes; exemple: écrire la première lettre de l'alphabet.

Stephenson soumet ses résultats à une analyse statistique très poussée qui le conduit à affirmer l'existence d'un facteur verbal dans tous les tests verbaux. Il attribue la différence entre ses résultats et ceux de Davey à la différence des tests utilisés.

Mais, puisqu'il n'est pas possible de contester le caractère verbal des tests de Davey, il n'est pas permis de conclure avec Stephenson que tous les tests verbaux contiennent un facteur commun et d'affirmer qu'il s'agit d'un facteur verbal général. Il faut chercher une signification particulière au facteur qui se manifeste dans tous les tests de Stephenson. On en trouve peut-être une indication si l'on compare dans leur ensemble les deux groupes de tests qu'il utilise. On constate alors que tous les problèmes des tests verbaux ont un contenu concret, tandis que parmi les tests non-verbaux un seul (lacunes d'image) appartient à ce type. Dans tous les autres tests non-verbaux, il faut manier des signes dépourvus de signification concrète et des figures géométriques. J'ai trouvé dans mes expériences sur les formes d'intelligence que des tests visuels à contenu concret n'ont pas exactement les mêmes facteurs que des tests à figures géo-

métriques, et il est permis de penser que le facteur de Stephenson tient à la nature concrète du matériel. Il est évident que cette remarque ne peut pas constituer une définition suffisante de ce facteur, mais elle peut faire comprendre qu'il n'a pas nécessairement un caractère verbal.

Une autre recherche parue deux ans plus tard entreprise par Belle Schiller ³⁾, sur la comparaison des tests verbaux, numériques et spatiaux donne de nouvelles précisions sur le problème du facteur verbal. L'expérience a été effectuée avec 359 enfants juifs âgés de 9 ans environ. Les résultats sont élaborés séparément pour les garçons et les filles, les deux groupes étant à peu près de grandeur égale. Nous comparons d'abord les tests verbaux aux tests numériques.

a. Tests verbaux:

1. Test de vocabulaire: chercher parmi cinq images celle qui correspond à un mot indiqué. Il faut, en outre, chercher parmi cinq mots celui qui ressemble le plus à un mot donné.
2. Test d'analogies, forme sélective.
3. Phrases avec lacunes. Une à trois lacunes par phrase, laissant dans certains cas celle-ci très incomplète.
4. Lecture silencieuse de textes présentant certaines difficultés de compréhension.

b. Tests numériques:

1. Test d'opérations; 2. problèmes arithmétiques; 3. test des séries de chiffres à compléter.

Examinant les différences tétradiques de ces tests, on ne trouve — contrairement aux résultats de Stephenson — pas trace d'un facteur particulier commun aux quatre tests verbaux. Mais chez les garçons aussi bien que chez les filles, on constate une ressemblance particulière entre les phrases à compléter et la lecture, et entre le vocabulaire et la lecture.

Il faut en conclure qu'il n'y a pas un seul facteur particulier mais deux, l'un se trouvant dans la première des deux couples indiquées, l'autre dans la seconde. Car si c'était le même facteur qui était responsable des liens dans les deux couples, il devrait également produire un lien entre les phrases à compléter et le vocabulaire.

³⁾ Schiller, B., *Verbal, numerical and spatial abilities of young children*. Arch. of Psychol. 1933, 156.

Opposés aux tests numériques les quatre tests verbaux auraient donc la composition suivante:

Analogies = $f(g, s)$ Phrases à compléter = $f(g, p_2, s)$
 Vocabulaire = $f(g, p_1, s)$ Lecture = $f(g, p_1, p_2, s)$

(g désigne un facteur général se trouvant dans tous les tests examinés; s désigne les facteurs spéciaux, p les facteurs de groupe qu'on peut aussi appeler des facteurs particuliers; p_1 et p_2 sont des facteurs différents).

Nous comparons maintenant les tests verbaux aux tests spatiaux. Parmi ces derniers il y a le dessin d'un bonhomme apprécié selon la technique de Goodenough. Les trois autres tests sont tous composés de problèmes de nature différente dont les résultats ne sont pas traités distinctement. Pour cette raison, nous renonçons à leur description détaillée; notons seulement qu'ils sont du genre de ceux employés par Stephenson et qu'il s'y trouve quatre tests de performance de la série Pintner-Paterson et plusieurs labyrinthes.

Les tétrades obtenues avec ces tests montrent la présence d'un facteur particulier commun à tous les tests verbaux, particulièrement accusé dans les tests de vocabulaire, de phrases et de lecture, plus faible, surtout chez les filles, dans les tests d'analogies.

Tous les quatre tests ont donc maintenant la même composition

Tests verbaux = $f(g, p_v, s)$

tandis que les tests spatiaux ne contiennent qu'un g et des s .

La situation se présente donc de la manière suivante: Dans la comparaison avec les tests numériques, (voir le tableau précédent), le test d'analogies paraît contenir seulement un facteur général et un facteur spécifique, contrairement aux autres tests, qui, eux, comportent des facteurs de groupe. Comparant les tests verbaux aux tests spatiaux, nous trouvons à côté du facteur g un facteur p_v qui est commun à tous les tests verbaux. Les facteurs p_1 et p_2 , par contre, ne se révèlent plus. La première question qui se pose au sujet de ces deux analyses différentes, est de savoir pourquoi en comparant les analogies aux tests numériques, on ne trouve pas le p_v . Il faut supposer qu'il en est ainsi parce que ce p se trouve également dans les tests numériques (leur composition sera alors: g, p, s) et s'y confond avec le g ,

tandis que les tests spatiaux ne le contiennent pas et par cela même le font apparaître. Mais peut on encore considérer se *p*, comme un facteur „verbal” puisqu’il jouerait un rôle également dans des tests numériques? Schiller pense que chez des jeunes enfants la „verbalisation” joue un grand rôle dans le calcul. Mais pourquoi le langage n’interviendrait pas tout aussi bien dans des problèmes avec des figures géométriques?

Mais même en admettant cette explication on ne pourrait pas considérer ce facteur verbal comme étant de la même nature que celui qui s’est révélé entre trois des tests dans la comparaison avec les tests numériques. Nous nous trouverons donc en face de deux ou trois facteurs qui tous seraient définis par leur caractère verbal sans que l’auteur ait fait une tentative de les différencier.

Une recherche entreprise par G. M. Smith ⁴⁾ ajoute encore quelques précisions au problème du facteur verbal. L’auteur a construit, avec beaucoup de soin, des tests présentant exactement la même structure tout en étant constitués par des matériaux différents (verbal, numérique, spatial). Il emploie:

- a. trois tests d’analogies, forme sélective;
- b. trois tests de généralisation dans lesquels il faut choisir, parmi cinq mots, nombres ou figures trois unités appartenant à la même espèce;
- c. trois tests de construction, dont les problèmes sont un peu différents suivant le matériel employé. Le test verbal consiste en phrases incomplètes; le mot manquant doit être trouvé parmi d’autres. Comme test numérique, on a choisi celui des séries de chiffres à continuer. L’épreuve spatiale est un puzzle formé par des figures géométriques. A ces neuf tests, l’auteur ajoute une épreuve d’analogies grammaticales et une épreuve d’analyse grammaticale.

	Analogies verbales	Analogies grammati- cales	Générali- sations verbales	Générali- sations gramm.	Phrases à compl.
Analogies verbales		x	x	x	
Analogies grammaticales	x			x	x
Généralisations verbales	x				
Généralisations grammaticales		x			
Phrases à compléter		x			

(Chaque croix indique un lien entre le test de la colonne et de la rangée respective).

⁴⁾ Smith, G. M. *Group factors in mental tests similar in material, or in structure.* Arch. of Psychol. 1933, 156.

Smith se sert de différentes méthodes d'analyse. Le tableau précédent indique les liens, qui se révèlent selon la méthode des tétrades moyennes.

Pour expliquer ces liens il faut admettre plusieurs facteurs de groupe et les compositions factorielles peuvent être écrites comme suit:

Analogies verbales = $f(g, p_1, p_2)$ Analogies grammaticales = $f(g, p_1, p_3)$

Généralisations verbales = $f(g, p_2)$ Généralisations grammaticales = $f(g, p_1)$

Phrases à compléter = $f(g, p_3)$.

Il y a donc au moins trois facteurs de groupe dans ces cinq tests verbaux et aucun des trois se rencontre dans tous. Voici ce qui ne parle guère en faveur d'un unique facteur verbal général!

Nous arrêtons ici cette revue des travaux sur le facteur verbal. C'est seulement dans les recherches de Stephenson qu'un facteur commun à tous les tests verbaux s'est révélé. Mais nous avons vu que ce facteur peut trouver aussi une autre interprétation. On est donc en droit de conclure qu'il n'y a pas nécessairement de facteur verbal chaque fois qu'un problème est d'ordre verbal. Il se pourrait par contre que certains problèmes de cette nature comportent un facteur de groupe qui devrait alors être défini plus exactement. Actuellement on désigne sous le nom „verbal” probablement plusieurs facteurs de nature plus ou moins différente. La notion d'*intelligence verbale* paraît, à la lumière de ces recherches également sujette à caution.

Le facteur numérique

Comme le mot, le nombre est un matériel nettement défini et on s'est souvent demandé si un facteur intellectuel particulier est associé au matériel numérique. Cette question est d'autant plus justifiée que le nombre est lié aux mathématiques, et que l'observation courante montre que celles-ci exigent quelques aptitudes particulières.

Le premier travail de quelque importance relatif à cette question paraît être celui de Collar intitulé „Statistical Survey of arithmetical Ability”⁵⁾. La recherche a été faite sur 200 écoliers (degrés III à VII); elle comporte les expériences suivantes:

⁵⁾ Br. J. Psychol. 1920, XI. P. 135.

1. Opérations d'arithmétique, leur rapidité et leur justesse.
2. Problèmes d'arithmétique.
3. Règles d'arithmétique. Ce sont encore des opérations mais choisies de manière à appeler l'application de toutes les règles apprises à l'école. On apprécie dans ce test les fautes dues à la connaissance insuffisante des règles.
4. Calcul mental.

L'auteur a examiné, en outre, l'orthographe, la lecture, la composition, l'histoire et la géographie. A part cela, les sujets furent soumis à deux tests d'intelligence d'ordre surtout verbal et composés de problèmes d'analogies, de phrases en désordre, de phrases incomplètes etc. La description détaillée des différentes expériences n'est malheureusement pas donnée.

Nous analysons les résultats de Collar par la méthode des tétrades moyennes qui n'était pas encore connue à ce moment-là. (Nous devons éliminer de ces calculs les Opérations parce que Collar ne donne pas les coefficients de corrélations entre ce test et les tests d'intelligence). Ce qui nous intéresse c'est de savoir s'il existe entre les différents tests d'arithmétique des liens qui ne peuvent pas être attribués au facteur „g” seul. A cette fin nous calculons les moyennes tétradiques caractéristiques, une première fois sans tenir compte des corrélations où entrent les tests scolaires non-arithmétiques et une seconde fois en tenant compte de toutes les corrélations. Les résultats obtenus se trouvent dans la première resp. seconde colonne du tableau suivant.

Couple de tests	Tétrades moyennes	
	Avec tests d'arith- métiques et tests d'intelligence.	Avec tous les tests.
Problèmes — Calcul mental	-0.0573	+0.1015
Problèmes — Règles	-0.0093	+0.0908
Calcul mental — Règles	+0.2120	+0.6250
Problèmes — Intelligence I	+0.0540	+0.1278
Problèmes — Intelligence II	-0.0073	-0.0462
Calcul mental — Intelligence I	-0.1460	-0.1000
Calcul mental — Intelligence II	-0.0705	-0.0878
Règles — Intelligence I	-0.1315	-0.0443
Règles — Intelligence II	-0.1513	-0.1658
Intelligence I — Intelligence II	+0.2280	+0.0519

(Erreur probable moyenne 0.0509)

Dans la première colonne on ne trouve que deux tétrades moyennes suffisamment importantes pour pouvoir être prises en

considération, celle entre Calcul mental et Règles, et celle entre les deux tests d'intelligence. Un facteur qui soit nécessairement lié aux problèmes numériques n'existe donc pas. Le facteur plus particulier qui existe entre Calcul mental et Règles doit trouver une explication spéciale.

Envisageons maintenant les tétrades de la seconde colonne. Le lien particulier entre les tests d'intelligence disparaît, — la tétrade a diminué — très probablement parce que les autres tests scolaires nouvellement ajoutés contiennent ce même facteur. Les trois couples de tests d'arithmétique par contre, montrent des différences tétradiques assez élevées. Celle entre Calcul mental et Règles est de nouveau la plus forte.

Résumons de nouveau la composition factorielle des différents tests telle qu'elle résulte de ces différences tétradiques:

	D'après les tétra- des de la première colonne	D'après les té- trades de la se- conde colonne
Problèmes	$f(g')$	$f(g'', p_3, p_4)$
Calcul mental	$f(g', p_1)$	$f(g'', p_3)$
Règles d'arithmétiques	$f(g', p_1)$	$f(g'', p_3)$
Intelligence I	$f(g', p_2)$	$f(g'', p_4)$
Intelligence II	$f(g', p_2)$	$f(g'')$

(Nous utilisons la notation g' et g'' pour indiquer qu'il ne s'agit pas, dans les deux cas, du même facteur général).

Il n'est naturellement pas possible de donner une explication définitive et précise de ces résultats, toutefois il est permis d'en dégager deux constatations:

1°) La signification du facteur g n'est pas la même dans les divers ensembles de tests. Dans l'ensemble complet, il englobe le facteur p_2 mais il ne renferme plus les fonctions psychologiques qui caractérisent particulièrement les tests numériques.

2°) Le facteur p_3 du second ensemble ne peut avoir un caractère typiquement numérique, parce que dans ce cas il aurait dû se manifester aussi bien dans le premier que dans le second groupe de tests.

Il n'est pas possible d'aller plus loin dans l'interprétation de ces résultats dont les rapports sont très complexes. En appliquant la méthode de Thurstone on obtiendrait peut-être de

nouvelles indications; mais la description des tests de Collar étant trop sommaire, cette analyse ne me semble pas pouvoir aboutir à des résultats qui justifieraient cet effort.

Quant au problème qui nous intéresse surtout, la réponse me paraît assez nette:

Il n'y a pas de facteur numérique général qui soit caractéristique de tous les problèmes de chiffres, bien qu'il y ait un facteur particulier, commun au Calcul mental et aux Règles.

Cette conclusion est en désaccord avec celle que Collar tire de ses résultats quand il déclare qu'il y a „un facteur spécifique unique⁶⁾ d'ordre mental opérant dans les différentes sortes de travail arithmétique”.

D'où vient ce désaccord dans l'interprétation des faits? Collar n'utilise pas la technique des différences tétradiques, mais celle des corrélations partielles. Après avoir déterminé, selon une formule proposée par Spearman, l'influence du facteur g dans les tests d'arithmétique, il calcule les corrélations partielles entre ses tests en maintenant l'intelligence constante. Ces corrélations étant toutes positives et significatives, Collar déduit qu'il y a un facteur arithmétique commun à tous ses tests.

Même en admettant que la technique suivie par Collar soit correcte (c.à.d. qu'il ait réussi à éliminer dans les tests numériques tout ce qui est purement intellectuel et pas davantage), on n'est pas nécessairement tenu à accepter sa conclusion. Rien, en effet, ne permet d'affirmer que les corrélations qui subsistent après l'élimination de tout ce que Collar attribue à l'intelligence, soient dues à un seul et unique facteur de groupe. Si tel était le cas, les différences tétradiques basées sur ces coefficients de corrélation partielles devraient être zéro, car le facteur numérique deviendrait, après l'élimination de g un nouveau facteur général. Or, en fait, on trouve pour la classe dont nous avons analysé les différences tétradiques: — O. 1229; + O. 2616; — O. 1387⁷⁾. Ces résultats correspondent donc à ceux que nous avons trouvés avec la méthode des tétrades moyennes: Il peut exister un facteur commun à tous les tests numériques employés par Collar,

⁶⁾ „Facteur spécifique unique” signifie dans notre terminologie „facteur de groupe”.

⁷⁾ Collar a calculé les corrélations partielles entre quatre tests; les six coefficients de corrélation ainsi obtenus donnent lieu à trois différences tétradiques.

dont le caractère numérique ne peut cependant pas être démontré, et un ou plusieurs facteurs particuliers.

Les expériences de Collar ont trait à des travaux d'ordre scolaire et on doit se demander quels sont les rapports entre des tests numériques de nature non-scolaire. Dans la recherche déjà citée de G. M. Smith nous trouvons les tests suivants:

Séries de chiffres à continuer.

Analogies numériques; la réponse est à choisir parmi quatre; par exemple: 64 — 8 : 169 — .. (11, 13, 26, 96).

Généralisations; les chiffres qui ont une qualité en commun sont à souligner; par exemple: 3, 15, 16, 21, 8.

Problèmes d'arithmétique.

Si l'on compare ces tests à des tests spatiaux, on trouve des tétrades moyennes significatives seulement entre des couples de Séries de chiffres-Problèmes et Analogies-Généralisations; si l'on compare ces tests aux tests verbaux, on trouve des liens entre ces deux mêmes couples et un autre lien entre Analogies numériques-Séries de chiffres. De nouveau, il ne se manifeste donc pas de facteur commun à tous les tests numériques.

Les expériences de B. Schiller déjà citées donnent des résultats qui ne parlent pas davantage à l'appui d'un facteur numérique général. Si l'on confronte les trois tests numériques de la série de Schiller (Séries de chiffres, Problèmes arithmétiques et Opérations arithmétiques) à des tests spatiaux, des liens apparaissent entre les trois tests. On pourrait donc faire ici l'hypothèse d'un seul facteur numérique. Mais opposés aux tests verbaux, les tests numériques ne révèlent plus de facteur commun unique: le lien entre Problèmes et Opérations disparaît. La preuve est donc faite que ces deux tests ne contiennent pas de facteur numérique et la conclusion des expériences précédentes trouve une nouvelle confirmation.

Brigham dans „A study of Error”⁸⁾ rapporte des coefficients de corrélations et des tétrades sur des tests de Séries de chiffres, de Problèmes arithmétiques et de Proportions arithmétiques. Comparées à des tests verbaux et spatiaux, ces épreuves donnent des tétrades qui sont toutes positives et indiquent des liens particuliers entre les trois tests numériques. Il est donc possible d'après ces résultats d'admettre l'existence d'un facteur numé-

⁸⁾ College Entrance Examination Board. New-York 1932.

rique mais le nombre réduit des tests ne donne pas une très grande portée à cette conclusion.

Sur quatre travaux un seul donne des résultats en faveur de l'existence d'un facteur numérique. Dans les trois autres recherches il se trouvaient toujours des tests numériques qui ne laissaient voir aucune trace de ce facteur de groupe. Il est donc probable que le facteur commun aux trois tests numériques de Brigham ait une autre signification et nous sommes de nouveau amenés à la conclusion *qu'il n'existe pas de facteur de groupe lié nécessairement à la nature numérique des problèmes.*

Le facteur spatial

Au matériel verbal et numérique s'oppose tout naturellement le matériel visuel et nous avons déjà vu dans les paragraphes précédents que des recherches avec ce troisième type de matériel ont été entreprises. Certains auteurs ont conclu à l'existence d'un facteur visuel. Ce terme de „visuel” me paraît cependant un peu trop vague. Faut-il y comprendre tous les problèmes présentés sous forme visuelle? On aurait alors à faire à des problèmes si divers que jamais on arrivera à des conclusions nettes et indiscutables.

Aussi, suivant en ceci plusieurs travaux récents, me bornerai-je à examiner l'existence d'un facteur spatial. Si ce dernier ne s'impose pas, le facteur visuel sera à plus fortes raisons à rejeter. Le terme spatial, désigne nettement des données caractérisés par leur *forme* plutôt que par leur signification. Un problème est d'ordre spatial lorsqu'il implique des relations de formes, de grandeurs, de positions. Nous nous demanderons donc, dans ce chapitre, si des problèmes de ce genre contiennent un facteur particulier.

Pour répondre à cette question, nous revenons aux recherches déjà citées.

Stephenson ⁹⁾ ne trouve pas de facteur spatial commun à tous ses tests, pas même de facteur limité à quelques uns d'entre eux. Ils paraissent tous déterminés par *g* uniquement.

D'après Smith ¹⁰⁾, il y a certains facteurs particuliers entre des

⁹⁾ op. cit.

¹⁰⁾ op. cit.

tests spatiaux, à savoir entre: Analogies spatiales, puzzles de Minnesota, et puzzles de Kelley.

Les deux premiers de ces tests ont été décrits plus haut; les deux derniers sont des sortes de puzzles, coupés en figures géométriques où le sujet doit indiquer de quelle façon une figure donnée se décompose en plusieurs éléments présentés. Par exemple, il faut dessiner la diagonale dans un rectangle pour montrer comment il se compose de deux triangles.

Le tableau qui suit résume les liens entre les différents tests tels qu'ils résultent de l'analyse à l'aide des tétrades moyennes. (Nous admettons l'existence des liens si la tétrade moyenne dépasse son erreur probable ¹¹). Sont indiqués par une croix les liens que se manifestent entre les tests spatiaux si on les compare aux tests numériques, par un cercle, ceux qu'on trouve en opposant les tests spatiaux aux tests verbaux.

	Puzzles (Minnesota)	Analogies	Générali- sations	Puzzles (Kelley)
Puzzles (Minnesota)			x o	x o
Analogies				o
Généralisations				

Sur les six couples qu'on peut former avec ces quatre tests, deux ou trois seulement montrent un lien particulier. Il est donc certainement faux d'affirmer qu'il existe un facteur spatial général. Celui qui se manifeste entre les deux tests de puzzles et qui est de loin le plus fort (la tétrade moyenne dépasse six fois son erreur probable) a probablement sa raison dans la forme très semblable de ces deux tests.

Les expériences de B. Schiller ne sont guère utilisables pour le problème qui nous occupe pour l'instant. Elles suggèrent l'existence d'un facteur spatial commun à tous les tests de ce genre pour les garçons et non pas pour les filles. Mais les tests utilisés sont composés de plusieurs sortes de problèmes différents et plusieurs de ces séries contiennent les mêmes problèmes, par exemple des labyrinthes. Ce matériel rend en tout cas impossible une détermination précise de la nature des facteurs.

¹¹) Nous donnons par cela plus de chance à l'apparition d'un facteur numérique qu'on le fait habituellement.

F. M. Earl¹²⁾ dans une recherche sur des tests d'aptitudes à la mécanique, conclut qu'il y a dans ses tests un facteur particulier qu'il appelle „perception spatiale”.

Earl utilise les tests suivants:

1. Un test collectif d'intelligence de l'Institut National de Psychologie Industrielle.
2. Un test d'aptitudes à la mécanique qui consiste dans l'assemblage de petits objets décomposés, par exemple sonnette de bicyclette, tournevis, etc.
3. Un test de relations spatiales, où il faut chercher parmi un certain nombre de pièces celle, qui complète un carré ou un cube.
4. Un puzzle géométrique de Dearborn.
5. Le tableau de Healy (lacunes).
6. Le test de Knox (mémoire de mouvement): Le sujet doit toucher quatre cubes dans l'ordre indiqué par l'expérimentateur.
7. Un test de construction avec des cubes.

Dans l'ensemble, les tétrades qui résultent des corrélations entre ces tests, dépassent de peu seulement leurs erreurs probables, et les liens entre les tests paraissent tenir surtout à un facteur général. Poursuivant son analyse, l'auteur calcule les coefficients de corrélation entre les tests spatiaux en maintenant constants les tests d'intelligence qui, d'après lui, s'identifient avec le facteur *g*. Ces corrélations partielles sont à peine plus faibles que les corrélations originales. La moyenne des premières étant 0.35, celle des dernières 0.30. L'auteur en déduit que, contrairement à ce que les faibles différences tétradiques semblent indiquer, des facteurs particuliers ou plutôt un seul facteur d'ordre spatial serait présent. En fait, par sa double technique, Earl prouve uniquement que le facteur général qui seul paraissait déterminer les corrélations, est en réalité un facteur composé; mais il ne peut pas affirmer que ces composantes soient véritablement le *g* et un facteur spatial général; une composition plus complexe est également possible.

Nous avons, de notre côté, analysé des tests spatiaux choisis parmi ceux qui sont utilisés depuis de nombreuses années à l'Institut des Sciences de l'Education à Genève.

1. Le test de Relation de formes de l'Institut National de Londres.
2. Un test de lignes enchevêtrées où il faut chercher à suivre chaque ligne du début à la fin (semblable à celui des Mechanical Aptitude Tests de McQuarrie).

¹²⁾ Earl, F. M., *Tests of mechanical ability. Studies of vocational guidance III*. The National Institute of Industrial Psychology, London, 1929.

3. Le test de Rybakoff: découper une figure en deux parties et assembler celles-ci de façon qu'elles forment un carré.
4. Le test des Leviers de Spielrein qui exige la représentation des mouvements d'un système de leviers.

Les corrélations de ces tests entre eux et avec quelques tests d'intelligence comme ceux des Séries de chiffres, des Séries d'images, des Analogies de figures et des Images avec lacunes calculées sur 100 jeunes gens entre 17 et 18 ans, tous élèves d'écoles secondaires, ne démontrent guère l'existence d'un facteur spatial général. On ne trouve de tétrades moyennes de quelque importance qu'entre les tests de Rybakoff et de Relations de formes. Il s'agit dans ces deux problèmes d'une *représentation spatiale* et non de la perception de figures ni de raisonnement sur des données spatiales.

Nous trouvons d'autres renseignements très intéressants dans un travail de Alexander intitulé „*Intelligence concret and abstract*”¹³⁾. L'auteur utilise dans son „Groupe IV” les tests suivants:

a. Tests de performance:

1. Le Passalong Test: dans une petite boîte se trouvent quelques morceaux — carrés et rectangles — qui, ne la remplissant pas complètement, peuvent être déplacés sans être extraits du contenant. Il s'agit de les déplacer et de les mettre dans une position indiquée.
2. Le test des Mosaïques de Koh.
3. Un test de construction avec des cubes.
4. Une combinaison de cinq planches de puzzles de la série de Pintner-Paterson.
5. Une combinaison de plusieurs tests d'images à lacunes.
6. Les labyrinthes de Porteus.
- b. Tests spatiaux de Spearman.
7. Analogies de figures.
8. Séries de figures.
9. Groupes de points: est donné un groupe de points à côté duquel se retrouve ce groupe entouré d'autres points qui ne laissent plus apparaître la configuration du premier groupe. Il faut la rechercher et en dessiner les contours.

c. Tests verbaux:

- 10 à 15. Six ensembles de tests verbaux et numériques empruntés à des tests collectifs de Terman et d'Otis.
16. La révision de Stanford du Binet-Simon.
17. Le test collectif d'auto-administration d'Otis.
18. Le test de lecture de Thorndike.

¹³⁾ Br. J. Psychol. Monogr. Suppl. XIX, 1935.

Alexander soumet les corrélations obtenues avec ces tests sur un groupe de 100 jeunes filles délinquantes âgées de 16 ans (d'autres groupes de sujets donnent des résultats très semblables) à une analyse selon la méthode de Thurstone et trouve la présence de 3 facteurs: un facteur général, un facteur verbal et un facteur „pratique”. Ce dernier facteur apparaît dans les tests de performance, (1 à 5) qui sont tous d'ordre spatial — et à un degré moindre, dans la série de Binet-Simon. Mais il est absent — et c'est là le point intéressant — dans les trois tests spatiaux de Spearman. Aussi l'auteur n'en conclut-il pas à l'existence d'un facteur spatial, mais d'un facteur „pratique”, qui est important pour l'habileté pratique. Sans vouloir nous prononcer sur ce dernier facteur, nous retenons que ces résultats confirment l'hypothèse selon laquelle il n'y a pas de facteur spatial général.

Nous pouvons de nouveau résumer l'examen de ces différentes recherches en disant qu'il paraît peu probable qu'un facteur spatial soit nécessairement présent dans tous les tests de ce genre.

CONCLUSIONS

Il résulte de nos analyses qu'il n'est pas justifié de parler d'une façon générale de facteur verbal, numérique et spatial, car il y a trop de recherches où ces facteurs ne se sont pas révélés malgré la présence de tests de la nature correspondante. Nous avons cependant vu que dans plusieurs travaux des liens particuliers existaient entre certains problèmes du même matériel et il reste donc possible qu'il y a des facteurs verbal, numérique et spatial de nature plus restreinte. Mais aucune tentative n'a été faite pour les caractériser exactement. Vu ces résultats peu favorables pour ces facteurs on peut s'étonner de l'insistance avec laquelle on en fait état. Je peux en trouver la raison seulement dans le souci d'objectivité qui retient les facteuristes d'une analyse psychologique plus subtile. Mais à quoi cette objectivité sert-elle si elle n'est pas accompagnée d'un égal effort de contrôle de la portée des conclusions? Est-ce vraiment être objectif que de se contenter de donner un nom aux facteurs trouvés sans en préciser le sens? Il me semble qu'on agit alors un peu à la manière de quelqu'un qui appellerait or tout ce qui est jaune et brille.

En dehors de tout examen comme nous l'avons tenté dans ce

travail, les facteurs qui correspondent à un caractère extérieur des problèmes sont d'ailleurs suspects parce qu'ils ne paraissent pas graduables. Or, les facteurs doivent être graduables puisque leurs saturations sont plus ou moins fortes suivant les tests. Il faudrait donc pouvoir expliquer pourquoi tel problème implique davantage du facteur verbal par ex. que tel autre. Or, je ne vois aucun indice extérieur qui puisse permettre de classer les problèmes suivant leur degré de verbalité etc. Un problème est verbal, numérique, spatial ou il ne l'est pas. Si l'on veut y faire une graduation, on peut admettre, comme le fait Spearman, que les facteurs sont dus à l'influence de connaissances particulières. Plus un test fera donc appel à certaines connaissances, plus important sera le facteur en question. Mais dans ce cas on ne serait plus en présence d'un seul facteur verbal par ex. mais d'autant qu'il y a de connaissances verbales particulières. Seulement les tests qui font appel aux mêmes connaissances feraient apparaître le même facteur et on comprendra alors pourquoi on ne trouve pas de facteur commun à tous les tests verbaux. Si sur le plan verbal et numérique cette réduction des facteurs à des connaissances paraît possible, on ne voit pas très bien comment on pourrait l'opérer pour le facteur spatial. Dans tous les cas, cette façon d'interpréter les facteurs de groupe ne permet pas de parler d'une façon générale d'un facteur verbal, numérique ou spatial; il sera toujours nécessaire de montrer dans chaque cas exactement quelles connaissances sont en jeu.

Il me semblait nécessaire de démontrer en détail l'inconsistance de ces interprétations pour rendre la route libre à d'autres conceptions. Il faudra, une fois pour toutes, se détourner de cette voie pour que les méthodes factorielles si riches en possibilités puissent vraiment être fertiles pour la psychologie. Il sera nécessaire que les facteuristes tiennent compte des données qu'apportent des recherches sur l'intelligence faites par d'autres méthodes (celles de la génétique par ex.) au lieu de travailler sur un plan qui est encore, en dépit de toutes les affirmations contraires, celui de la théorie des facultés. Dans quelques recherches publiées récemment ¹⁴⁾, j'ai essayé une interprétation de facteurs basée sur les conceptions gestaltistes. Il me semble en effet que la théorie de la Gestalt présente le cadre le plus

¹⁴⁾ R. Meili; *L'analyse de l'Intelligence*. Arch. de Psychol. Vol. XXXI, 1946.

favorable à une interprétation psychologique des facteurs. Les actes d'intelligence, selon cette théorie, étant considérés comme des transformations de structure, leur diversité doit reposer sur des propriétés variées des structures intellectuelles et des processus de transformation, et c'est sur ce plan que doivent être interprétés les facteurs.

POSSIBILITIES AND LIMITATIONS OF TWIN RESEARCH AS A MEANS OF SOLVING PROBLEMS OF HEREDITY AND ENVIRONMENT

by

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I. *Twin research and the problems of heredity and environment.*

Twin research is often used to throw light on various aspects of the problems of heredity and environment. So far, the attention has been concentrated mainly on the relative importance of heredity and environment in creating differences in man. Investigations in this field are based on the fact that there are two kinds of twins: *Identical* or one-egg twins, who are of identical heredity, and *fraternal* or two-egg twins, of different heredity. Fraternal twins may be of the same or opposite sex, but it is customary to exclude the latter category in comparisons between identical and fraternal twins, in order to keep the sex factor constant. By considering the intra-pair differences found in identical twins (*IT*) and those found in same-sexed fraternal twins (*FT*), attempts have been made to evaluate the relative importance of differences in heredity and environment. This

has been done in various ways depending upon whether we have to do with characteristics which may be either present or absent (alternative characteristics), or characteristics which are always present but which may differ in degree (fluctuating characteristics).

With regard to *alternative characteristics*, such as harelip, diabetes, and colour blindness, the percental concordance and discordance in *IT* and *FT* is found for a great number of pairs. If a given characteristic is found always to be concordant in *IT*, and not always concordant in *FT*, the characteristic is said to be "hereditary", its appearance depending on factors of heredity. If the characteristic is found not always to be concordant in *IT*, its appearance cannot be ascribed exclusively to hereditary factors. If a discordance occurs as frequently in *IT* as in *FT*, the characteristic is "non-hereditary". The appearance of the characteristic then depends exclusively on environmental factors. If the characteristic is found to be discordant in *IT*, but not so frequently as in *FT*, the characteristic may be assumed to arise from a hereditary disposition, not asserting itself under all conditions.

In the case of *fluctuating characteristics*, such as height, weight, intelligence, and attitudes, the intra-pair differences of *IT* and *FT* are determined in order to ascertain whether the average pair differences are greater in one group than in the other. As *IT*-partners are of identical heredity (and, of course, of the same age), it has been assumed that differences between them must be due wholly to environment or, rather, to *environmental differences*, i.e. differences in the environmental influences exerted on the members of each pair. The term *environmental influences* is here used in the widest sense, including even pre-natal influences. *FT*-partners, on the other hand, are more or less different with regard to heredity, and differences between them may thus also be due to different heredity. Consequently, intra-pair differences of *IT* are ascribed to environment, whereas intra-pair differences of *FT* may be due to both heredity and environment. In general, the intra-pair differences are found to be greater in *FT* than in *IT*. If in a large number of *IT* and *FT* the mean difference for a given characteristic in *IT* (mD_{IT}) is compared with the mean difference in *FT* (mD_{FT}),

mD_{IT} may stand for the share of environment, and the excess difference in FT ($mD_{FT} - mD_{IT}$) for the share of heredity in intra-pair differences in FT . If the excess difference is found to be comparatively small, the intra-pair difference in FT is due mainly to environmental differences. If the excess difference is comparatively great, the difference between the FT -partners is due mainly to differences of heredity.

Some students of twins have thought it possible, on the basis of calculations of intra-pair twin differences, to find the accurate percentages of the shares of heredity and environment in respect to a given trait, and several mathematical formulas have been worked out for the relation between the influences of heredity (H) and environment (E). Of these formulas the following are the most important:

1. *The difference method*, used by Lenz and von Verschuer (1928) and Holzinger (1929):

$$\frac{H}{E} = \frac{mD_{FT} - mD_{IT}}{mD_{FT}} \div \frac{mD_{IT}}{mD_{FT}} = \frac{mD_{FT} - mD_{IT}}{mD_{IT}}.$$

This formula was originally intended to express only the relative shares of heredity and environment in intra-pair differences of FT , but it has been employed not infrequently by other investigators without this limitation.

2. *The quotient method*, used by Gottschaldt (1939, p. 157) and stated by him to be devised by von Verschuer:

$$\frac{H}{E} = \frac{mD_{FT}}{mD_{IT}}.$$

3. The method employed by Lenz (1935) after stating the binomial combination of hereditary and environmental influences:

$$\frac{H}{E} \cong \frac{mD_{FT}^2}{mD_{IT}^2} - 1.$$

Later (1941/42) he seems to have rejected this formula, too, as all other formulas for $\frac{H}{E}$.

4. The method of Wilde (1941):

$$\frac{H}{E} = \sqrt{\frac{mD_{FT}^2}{mD_{IT}^2} - 1}.$$

This formula, which is also mentioned by Luxenburger (1940, p. 235), bears exclusively on a population consisting of twins only.

5. The method of Dahlberg (1942 a), indicated as early as 1926. The method resembles that of Wilde, but instead of mean difference Dahlberg employs the standard deviation $\sigma = \pm \sqrt{\frac{\sum D^2}{2N}}$, where σ is the standard deviation of each individual, D the intra-pair differences, and N the number of twin pairs. The formula is based on the equation:

$$\sigma_{H+E} = \sqrt{\sigma_H^2 + \sigma_E^2}.$$

In this equation σ_H and σ_E are taken to be independent variables.

Further, he assumes that

$$\sigma_{H+E} = \sigma_{FT}, \text{ and } \sigma_E = \sigma_{IT},$$

arriving finally at the formula:

$$\frac{\sigma_H}{\sigma_E} = \sqrt{\frac{\sigma_{FT}^2}{\sigma_{IT}^2} - 1}.$$

Dahlberg points out that the formula should be used with care, and that the results cannot be used as a basis for conclusions regarding the population in general. The variability of heredity in FT as well as the variability of environment in the whole population, corresponding only to the variability within the same family.

The question of the validity of such formulas for $\frac{H}{E}$ will be discussed later.

If the two groups of twins are not quite identical with regard to, say, age and sex, it is customary to use the *mean percental deviation* instead of the absolute quantity mD . In these cases the so-called percental deviation is first found for each twin pair:

$$\% D = \frac{(x_1 - x_2) \cdot 100}{2} \div \frac{x_1 + x_2}{2} = \frac{D \cdot 100}{x_1 + x_2}.$$

where x_1 and x_2 are the measures of the two twin partners and D the arithmetic difference between x_1 and x_2 . The *mean percental deviation* is then found by means of the formula

$$m(\% D) = \frac{\Sigma(\% D)}{N},$$

where N is the number of twin pairs and $\Sigma(\% D)$ is the sum of the percental deviations of the twin pairs. The use of $m(\% D)$ depends on the assumption that the measuring scale has an absolute zero and that it is homogenous (i.e. that the unit of measurement is identical along the whole scale). (Cp. Wilde, 1941.)

Another method based on mass statistics for the comparison of *IT* and *FT* is to find the *correlation* between the two partners of *IT*- and *FT*-pairs, and see how much the coefficients differ. It is relevant here to use the so-called "intra-class correlation" and put down the data of both partners along both axes of the correlation table.

A particularly interesting material for the comparison of *IT* and *FT* is provided by two-egg triplets and two- or three-egg quadruplets, all of the same sex. These sets of "super-twins" may be considered as combinations of *IT* and *FT*, and they constitute quite unique cases of *IT* and *FT* born at the same time and brought up in the same environment. Such cases are very rare and investigations in this field can only be casuistic.

Besides comparisons of *IT* and *FT* there are other ways in which twin research may throw light on the problems of heredity and environment. Investigations are then confined to *IT*. Among other things, it might be possible to throw some light on the *capacity of environment to produce differences between persons of identical heredity*. On the assumption that *IT*-partners are of identical heredity, all proven differences between *IT*-partners must be due to the fact that the two partners have been exposed to different environmental influences. The kind and the degree of these differences can be determined, and the conclusion may be drawn that environment is able, at least, to create differences of the kind and degree that has been observed.

In this connection it may be mentioned that in the case of diseases with a hereditary background, a determination of differences in the appearance and the development of the disease

in *IT* may be of importance in still another way. As pointed out by Luxenburger (1932) and Essen-Möller (1941 a), a study of insane *IT* may be very useful for psychiatry. It may influence the *classification of psychosis* and show in how far one is justified in grouping certain clinical symptoms together as syndromes and the syndromes together as nosological units. Differences in the clinical pictures of the two partners may show the possible varieties of the same mental disease.

By comparing the mean intra-pair differences for various characteristics in *IT*, it might be possible to throw light on the *relative para-variability* of the hereditary characters, i.e. state to what extent the phenotype of the various characters depends on the kind of environment. But this statement depends on the characteristics in question being measurable by the same scale.

In the case of alternative, heredity-dependent characteristics it has been assumed to be possible, from the frequency of concordance and discordance in *IT*, to arrive at conclusions concerning the "*probability of manifestation*" of the various hereditary characters, i.e. the probability of some character present finding expression. This is the case with the predisposition to polydactyly, schizophrenia and tuberculosis.

Two formulas have been devised for this probability of manifestation, the one by Lotze (1937, p. 66) who takes up a suggestion by von Verschuer (1932), and the other by Luxenburger (1940, p. 225), but the formulas have been worked out on the same basis, and can be deduced from one another.

Von Verschuer lets $\frac{1}{a}$ represent the probability of a character not manifesting itself in an individual (the probability of latency). The probability of manifestation *M* can then be expressed as follows:

$$M = 1 - \frac{1}{a} = \frac{a-1}{a}.$$

The character may manifest itself in both partners (positive concordance) or only in the one (discordance), or in neither (negative concordance). The probability of the character becoming apparent in both partners, is:

$$\frac{a-1}{a} \cdot \frac{a-1}{a} = \frac{(a-1)^2}{a^2}.$$

The probability of the character becoming apparent in neither of the partners, is:

$$\frac{1}{a} \cdot \frac{1}{a} = \frac{1}{a^2}.$$

Further, von Verschuer assumes that the probability of only one partner becoming the carrier of the character, in accordance with the rules for binomial combination, is equal to the double product of manifestation probability and latency probability:

$$2 \cdot \frac{1}{a} \cdot \frac{a-1}{a} = \frac{2a-2}{a^2}.$$

If the carriers of the character are negative-concordant pairs, they cannot be traced. But the relation between positive-concordant pairs and the sum of positive-concordant and discordant pairs can be determined. In the following this relation is represented by K .

Assuming that the above argument holds good, the following proportion is valid:

$$\frac{(a-1)^2}{a^2} \div \frac{2a-2}{a^2} = K \div (1-K).$$

From this equation we may, like Lotze, deduce:

$$a = \frac{1+K}{1-K}$$

and consequently:

$$\text{the manifestation probability } M = \frac{2K}{1+K}.$$

Luxenburger has devised a still more simple formula for the manifestation probability. In his formula the number of positive-concordant pairs is k , the number of discordant pairs is d , and the number of negative-concordant pairs is x . The total number of character-carrying twin pairs is then $k+d+x$. Supposing a binomial distribution of individuals with manifest and latent character, we arrive at the equation: $d = 2\sqrt{k \cdot x}$, and

$$X = \frac{d^2}{4k}. \quad \dots \dots \dots (1)$$

From the definition of manifestation probability (M) follows that

$$M = \frac{2k + d}{2(k + d + x)}.$$

By inserting (1), we get:

$$M = \frac{2k}{2k + d} = \frac{1}{1 + \frac{d}{2k}} \dots \dots \dots (2)$$

Luxenburger points out that the formula becomes somewhat complicated if the character is manifesting itself at a late period. The validity of these formulas will be discussed later.

It is of special interest to find differences and similarities in *IT*-partners whose lives differ in crucial features, for instance *IT*-partners separated in early childhood and grown up at different places. By comparing the mean differences between *IT*-partners reared apart with the mean differences between *IT*-partners reared together, we may get an idea of the relative role on the one hand, of the various influences exerted on children brought up in the same home, and, on the other hand, of the additional environmental influences on children brought up in different families. If we might venture experimental placements of *IT*-partners in different environments, and if for instance we might let them be brought up after totally different methods, we would most likely arrive at interesting results. But human lives are certainly too precious to be subject to such radical infringements on their developments.

Further, case-histories of *IT* may throw light on the causal relation between environmental and individual differences. We may partly search for the *causes* of differences observed in *IT*-partners, partly for the *effects* of differences observed in the developmental factors. This promising field of research has been pointed out by several authors, but so far it has received but little attention.

Finally, by way of experiment we may expose the two partners to different influences and study the results. In this way we may for instance elucidate the relative importance of *maturation* and *training* for the development of a given ability.

Then the one twin partner receives training in the ability in question, whereas the other partner receives no such training. Later the roles may be exchanged. This has been called the *method of co-twin control* (Gesell and Thompson, 1929).

II. Discussion of the theoretical basis of "twin methods".

The use of twin research to throw light on the problems of heredity and environment rests mainly on five basic assumptions, namely:

1. Twins derived from a single fertilized ovum (identical twins), is of identical heredity, whereas twins developed in other ways (fraternal twins) is of more or less different heredity.
2. Heredity and environment are the sole factors which can give rise to differences between twin partners, so that differences between twin partners of identical heredity (IT) with certainty can be ascribed to environmental factors.
3. It is possible in practice to make the differential diagnosis between IT and FT with sufficient certainty.
4. The two groups of twins that are compared are equivalent and, accordingly, directly comparable with respect to the matters under investigation. The two groups may be:
 - a) IT and FT, in investigations on the relative importance of heredity and environment;
 - b) IT-partners reared together, and IT-partners reared apart, in investigations on the importance of environmental differences;
 - c) IT-partners, in investigations on the relative role of maturation and training.
5. Twins do not differ crucially from singletons in the traits under observation.

The validity of each of these five basic assumptions are discussed in the following paragraphs.

1. The hereditary identity of one-egg twins.

Some authors have doubted that one-egg twin-partners are of identical heredity. Among them we may mention Orgler (1935), whose investigations on over 100 baby twin pairs brought

out so obvious differences in the behaviour of the twins even at this early age, that he was led to assume that *IT*-partners need not be of identical heredity, although their hereditary similarity may be greater than for other individuals.

Bouterwek (1934) likewise finds no other satisfactory explanation of the comparatively great number of cases of mental discordance in *IT* reared together. In the great majority of these cases, he asserts, the observable environment has been the same, and no environmental influences can be found to account for the differences in the general make-up of the partners. He finds a possibility of explaining these differences in the phenomena of asymmetry. He assumes that divergencies in bisymmetrical beings from the entirely symmetrical form are due, in the first place, to a difference between the genes of the two body halves. In his opinion, *IT*-partners correspond to (or "are homologous with") two body halves of a singleton, and accordingly, they will be as different with regard to heredity as the right and left halves of the body. In this way hereditary asymmetrical differences, for instance in the brain, may be supposed to arise between *IT*-partners. But the dominance of a different brain hemisphere in the two partners may further be assumed to be connected with different mental traits.

This assumption of the two body halves having different genes is considered by leading students of heredity as being invalid (cp. von Verschuer 1932, Gottschick 1937, Lotze 1937, and others). Moreover, the fact that there is little or no connection between the various forms of asymmetries does not seem to agree very well with Bouterwek's hypothesis. In his book published in 1943, Bouterwek seems to have abandoned the view that *IT*-partners are not of like heredity, but he still emphasizes that the main source of differences between *IT*-partners is the discordance of asymmetrical development courses. He calls this phenomenon "*Rechts-Links-Abwandlung*", letting it comprise the manifestations of all developmental processes that take different courses in the two body halves.

A similar view, although somewhat differently expressed, has been maintained earlier by Dahlberg (1926, 1930, 1942). He holds that *IT*-partners are genotypically identical, but considers it possible for hereditarily occasioned differences to arise through what he calls "genotypical asymmetries": "*Eine genotypische*

Asymmetrie ist eine erblich bedingte Eigenschaft, die sich asymmetrisch im Soma manifestiert, nicht auf Grund von Milieufaktoren, sondern auf Grund einer durch die symmetrisch verteilten Gene verursachten asymmetrischen Organisation des Somas. Die genotypischen Asymmetrien können daher bei EZ erblich bedingte Verschiedenheiten hervorrufen, obgleich die Zwillinge genotypisch gleich sind." (1930, p. 147).

In our opinion Dahlberg has touched upon a very important point, but he has expressed himself in a somewhat unfortunate way, as there cannot possibly exist actually heredity-determined differences in individuals of identical heredity.

But even apart from the possibility of asymmetrical dissimilarities determined by heredity, hereditary differences in IT may be assumed to arise through: a) an uneven distribution of the chromosome set on the two halves of the ovum at the first segmentation of the zygote, b) somatic mutations in one partner or both, after the division. However, these theoretical possibilities are hardly of any significance in practice. After discussing this question, von Verschuer draws the following conclusion: "Es ist somit kein einziger Beweis erbracht, der eine regelmässig oder auch nur selten vorkommende erbliche Verschiedenheit zwischen EZ wahrscheinlich machen könnte" (1933, p. 87).

Further, there is a possibility of twins developed from two fertilized ova being of identical heredity, but this possibility is so small that it may be totally excluded. From the number of chromosomes Lotze (1937, p. 50) calculates the probability of two siblings having cells with identical chromosome set to be

$$1 \text{ to } (2^{24})^2 \approx 1 \text{ to } 280 \cdot 10^{12}.$$

2. *Heredity and environment as sole causes of intra-pair twin differences.*

The assumption that differences not determined by heredity are synonymous with differences determined by environment, and that differences not determined by environment are synonymous with differences determined by heredity, is now rather generally accepted.

Exceptions are formed by Newman-Freeman-Holzinger (1937) who include the asymmetry mechanism in the twinning process as a third factor, and Dahlberg (1948) who calls this third

factor "chance", i.e. factors due to random variation in the cells of the two partners. The problem of how asymmetries arise, has not as yet been completely solved, and different kinds of asymmetry may have different geneses. But if there is reluctance to accept the theory of there being, in some way or other, a connection between discordant asymmetry in *IT* and an asymmetrical distribution of the hereditary make-up, there seems to be no reason to doubt that this discordance is determined by environment. Then the environmental factor must be assumed to have started to exert its influence at a very early stage of the twinning process. Thus we have to do here with environmental influences of a somewhat special nature, a fact of importance for the interpretation of results of twin research.

3. *Certainty of the differential diagnosis of IT and FT.*

Earlier it was generally assumed, as is still done by some, even by obstetricians, that *IT* are always developed in a single chorion, whereas *FT* are born in separate chorions. German investigators have shown that this assumption does not hold good. The fact is that *IT* may sometimes be monochorionic and sometimes dichorionic. Sometimes they may even have a single amnion. These variations depend on at what stage of development the twin cleavage has taken place. If the separation occurs already at the first stage of the segmentation, the two eggs may adhere to different places in the uterine mucous membrane, and each egg will develop independently and have its own chorion. The division may also take place after the egg has been embedded in the membrane; the trophoblast, which is later to become the chorion, has then been already developed, and the two embryos will have a common chorion. If the cleavage takes place at a sufficiently late period, they will also have common amnion. No certain case has been found of monochorionic *FT*-pairs, and if, therefore, a twin pair have been born in a single chorion, we may assume that they are *IT*. However, the true condition of the fetal membranes is not always easily observed. In some cases secondary fusions of two separate chorions may occur, and the true state of affairs can be brought to light only through microscopical investigations. However, such careful investigations have not often been made.

Other methods, therefore, are generally used in diagnosing twins. Siemens (1924) was the first to advocate the "*poly-symptomatic similarity diagnosis*", which consists in the comparison of twin pairs in respect of hereditary-determined characteristics which show great variability in the population.

One of the objections to the similarity diagnosis is that it is based on a circular reasoning: *IT* are one-egg because these twins display great similarity in hereditary-determined characteristics; hereditary-determined characteristics are hereditary-determined because they show great similarity in *IT*. This objection, however, is not so serious as it may seem at first. The hereditary determination of a characteristic may be proved by other methods than comparisons of twins. In psychological research there is no basis at all for the objection, because here other characteristics are investigated than those on which the diagnosis is based.

Gottschick (1937) doubts whether the polysymptomatic similarity method is sufficiently certain for an accurate diagnosis of twins. In the first place, he says there are siblings who are very much alike. Accordingly, there sometimes are very similar *FT*-partners, and theoretically there is no reason why *FT*-partners should not be of identical or, at least, practically identical heredity. Secondly, there may sometimes be considerable phenotypical differences between *IT*-partners. In some doubtful cases this method of diagnosis will be inapplicable and he stresses the necessity of a research control based on a material of monochorionic twins.

Lehtovaara (1938, p. 43) also stresses the impossibility of making an accurate distinction, on the ground of phenotype, between *IT* and *FT*.

Essen-Möller (1941b) has controlled the polysymptomatic similarity diagnosis through investigations on a great number of twins, and described it as being very reliable. All mono-chorionic pairs were polysymptomatically diagnosed as *IT*, and apart from two exceptions, all same-sexed pairs belonging to different blood types (i.e. proven *FT*) were diagnosed as being *FT*. The two exceptions he assumes may be due to faults in the determination of blood type.

To-day there is practically no disagreement as to the possibility of distinguishing with sufficient certainty between *IT*

and *FT*. A valid diagnosis of twins not proved to be monochorionic, depends on careful morphological investigations undertaken by experienced students of twins, except in cases of *FT* with particularly striking differences. Particularly careful examinations are required if the two partners cannot be examined simultaneously. Further, the twins must be past babyhood, as twins younger than one year cannot easily be diagnosed.

If in some cases there is doubt whether we have to do with *IT* or *FT*, we may, in order to be on the safe side, class these doubtful cases in a separate group. It is also possible, as advocated by Gottschick (1937), to confine oneself to a comparison of monochorionic twins (proven *IT*) and twins belonging to different blood groups (proven *FT*).

4. The comparability of twin groups.

As for the validity of the assumption that the twin groups can be compared, we had better discuss separately each of the three chief ways of twin comparisons: a) Between *IT* and *FT*, b) between *IT* reared apart and *IT* reared together, and c) between the *IT*-partners themselves.

The conclusion that the difference $mD_{FT} - mD_{IT}$ is determined by heredity, is based on the assumption that differences in the environmental influences of *IT* and *FT* on an average, are of equal importance. This assumption, however, is considered by many as being open to doubt. It has been pointed out that the social psychological structure assumes a different form for *IT* than for *FT*.

The first to indicate differences in *IT* and *FT* in the field of social psychology seems to have been Schulte (1928). In *IT* he found a great tendency for identification, whereas polarity and rivalry were characteristic of *FT*.

Poll (1930, p. 446) also points out that intra-twin relations may differ according as we have to do with *IT* or *FT*. In the case of twins being reared together, an one-egg twin will have a genotypically identical partner, whereas a two-egg twin will have a genotypically different partner. From the point of view of environment, this makes a great difference which will contribute

to the development of greater intra-pair differences in *FT* than in *IT*.

Hartmann and Stumpfl (1930) stresses the fact that "die Besonderheit gegenseitiger Gefühlsbindung bei den eineiigen, die sicherlich teilweise reaktiv auf die Wahrnehmung der Ähnlichkeit und auf das Verhalten der Eltern, Lehrer usw. (Verwechslung!) entstanden zu deuten ist und die auf dem Wege der Identifizierung die grösstmöglichen Chancen gegenseitiger Beeinflussung schafft, hier, bei den psychischen Merkmalen, für die sonst einwandfreie Galtonsche Vergleichsmethode eine Fehlerquelle werden kann, über deren tatsächlichen Umfang im konkreten Fall man sich ohne genaue genetische Analyse kaum Rechenschaft zu geben vermag" (p. 253).

Stocks (1930) points out that in many *FT* the partners "are very different in general body build, healthiness, tastes, and temperament, so that they naturally tend to subject themselves or be subjected to differences in nurture to a greater degree than monozygotic twins who have usually the same needs, tastes, and inclinations, and are rarely seen apart during childhood. To take one example, it is known that the amount of food required by a growing child varies greatly from one individual to another, and might be quite different in a pair of dizygotic twins, so that in a poor home one would tend to suffer from insufficient food more than the other. This would mean in general that in a random group of like-sexed dizygotic twins the mean effect of nurture in producing differentiation will be greater than in a random group of monozygotic twins, and hence the mean difference in any measurable factor due to nurture alone may be greater in the dizygotic than in the monozygotic."

Köhn (1931, p. 72) asserts that, according to his experience, differences determined by environment are greater in *IT* than in *FT*. He gives two reasons for this: 1. Strongly differentiating prenatal conditions, most marked in *IT*. 2. Modifying environmental influences of sociological kind. The quite unique fact that two persons of identical heredity grow up together, leads to unique social conditions which bring about a diverging development for the *IT*-partners. In his opinion, the urge to self-assertion and self-expression makes itself more clearly felt in *IT* than in *FT*. Owing to this tendency, *IT* react, in their mental

development, to environmental differences which as yet fail to influence a twin pair of different heredity.

Further, Köhn mentions the principle of division of labour, which in *IT* may cause crucial differences to be impressed on the phenotypes, whereas this principle in *FT* is only of secondary importance as compared with hereditary differences.

Von Hofsten (1931, p. 61) points at the *a priori* probability that *IT*, just by reason of their identical hereditary make-up, choose a similar environment oftener than other twins who may differ greatly in character, capacities, and propensities. We may therefore expect to find certain purely environmentally determined characteristics to differ less in *IT* than in *FT*. To take a freely invented example, it is quite probable that investigations would show that *IT*-partners oftener than *FT*-partners both choose a military profession, or both go in for sport; the result is that resemblance in physical strength, muscularity, etc. is more common than in *FT*. We should therefore be wrong, on the ground of this resemblance, to draw conclusions concerning the hereditary basis of these characteristics. This source of error may, of course, often be excluded or it may prove to be of minor importance, but it should be noted in the case of characteristics that may be influenced by a "genotypically determined choice of environment", especially in investigations on psychological characteristics.

Bleuler (1932, p. 298) is convinced that the assumption that the difference due to environment is equally great in *FT* and *IT*, does not agree with the natural facts. So far from acting upon the individual independently, environment and hereditary disposition stand in a relation of reciprocal causality. To a certain extent man creates for himself the environment which acts upon him. Thus *IT* are more likely to have similar social interests than twins genetically dissimilar. The result is that they create for themselves an environment which is more uniform than that acting upon *FT*.

Further, he points out that different environments may be due to purely physical characteristics. If one partner of a *FT*-pair has a more prepossessing face than the other, they will meet with very different treatment from their parents, brothers, sisters, teachers, comrades, and from members of the other sex.

Hartmann (1933, p. 202) points out that the unique form of attachment and preparedness for identification found in *IT*, may constitute a source of error in psychiatric twin investigations, there being a possibility of an *induction* of the psychotic condition if the twins during the illness or before have not been separated.

Wilson (1934), like von Hofsten, stresses the fact that *IT*, being of identical heredity, *seek* a more similar environment than do *FT*. By way of comparison he mentions the behaviour of chickens and ducklings hatched together. Seeing the ducks swimming in the pond, the chickens and ducklings seek different environments.

Von Bracken (1934 a) raises the question whether environment actually has the same differentiating effect on *IT* as on *FT*. On the background of investigations made by himself, he points out a number of facts that cause him to give a negative answer to this question.

Later (1936 a) he has carried on the discussion of the problem of this source of error: "Während also das Streben nach Überlegenheit in erbverschiedenen Zwillingspaaren sehr lebendig ist, bemerken wir in erbgleichen Zwillingspaaren eine aussergewöhnliche Wertschätzung der Gleichheit." (P. 77.) "Die Werthaltung zu Gleichheit bzw. Überlegenheit bedeutet eine Fehlerquelle für die erbwissenschaftlich orientierte psychologische Zwillingforschung: Die Paarlinge eines Paares, das stark auf Überlegenheit eingestellt ist, werden in vielen Fällen verschiedene Betätigungsgebiete suchen, um in solchen Sonderbereichen dann dem Partner überlegen zu sein. Aus dem Streben nach Überlegenheit ergibt sich also leicht eine *Differenzierungstendenz*, die u. U. die psychische Entwicklung in Richtung auf Vergrößerung der Unterschiede zwischen den Partnern beeinflussen könnte. Umgekehrt entsteht aus dem Gleichheitsstreben leicht eine *Uniformierungstendenz*, durch die u. U. verhindert wird, dass sich Eigenschaftsdifferenzen zwischen den Partnern bilden. Da die erbbiologische Zwillingforschung stets von Eigenschaftsdifferenzen der Zwillinge ausgeht, ist es für sie sehr wichtig, Differenzierungs- und Uniformierungstendenzen sowie ihre Wirkungen scharf zu erfassen; sobald das geschehen ist, kann man leicht die durch diese Tendenzen verursachten

Fehler ausschalten." (P. 78.) This source of error tends to increase mD_{FT} in relation to mD_{IT} .

Von Bracken also draws attention to the fact that the division of roles between the twin partners may give rise to a source of error working in the opposite direction. In an investigation on writing speed the outwardly-directed twin partner generally turned out to write faster than the other at ordinary writing speed, and from this he concludes that the outward representation ("die Aussenvertretung") in the course of time influences the character of its bearer so as to find graphological expression in a change of the writing speed in relation to the other partner. Provided that the differentiation into an outwardly- and an inwardly-directed partner is most marked in *IT*, a social-psychological source of error will arise, enlarging mD_{IT} in relation to mD_{FT} .

Kerr (1936) suggests the possibility of *IT*-partners having so much in common that they may tend to become temperamentally different as a conscious or unconscious protest.

Lunde (1937), in order to show that environmental differences are greater in *FT* than in *IT* when the partners grow up in the same home, draws attention to the following points:

1. There is greater probability of *IT*-partners than of *FT*-partners being treated alike, for while *IT*-partners nearly always look quite alike in external appearance, *FT*-partners do not. And it is not improbable that there will be greater difference in the treatment of a plain and a pretty child than in the case of two children looking exactly alike.

2. The surroundings pay a lot of attention to the fact that the children look alike. Owing to the greater intra-pair likeness in *IT*, the influence of this attention will be more marked in *IT*.

3. There is no doubt that *IT*-partners from their birth are more alike than *FT*-partners. Accordingly, a given stimulus will cause a more similar reaction in *IT*, and consequently also leave more similar memory traces, than in *FT*. The next time the children are exposed to a corresponding or similar stimulus, the earlier traces will become active. As the memory traces and thus the reception apparatuses are still practically alike in *IT*, the reactions will also this time be approximately alike. In *FT*, on the other hand, the difference of the memory traces will in-

crease the difference of the reception apparatuses, causing the difference of reaction to be even greater than before. This development will continue on further repetition. The result is that *IT*-partners, owing to their approximately identical reception apparatus, have a practically identical experience of the same environment, which is not the case in *FT*. On the basis of psychoanalytical experiences, we may expect this theory to have a special bearing on emotional traits.

Of other authors who find reason to believe that environmental conditions are not equivalent for *IT* and *FT*, we may mention: Carter (1932, p. 653, and 1940, p. 246), Herrman and Hogben (1933, p. 125), Kroh (1935, p. 86), Stumpf (1936, p. 131), Kranz (1936, p. 143), Gottschaldt (1937, p. 521), Newman-Freeman-Holzinger (1937, pp. 111, 114, 335), Reinöhl (1937, p. 43), Lehtovaara (1938, pp. 19, 299), Schäfers (1940, p. 492), and Woodworth (1941, p. 12).

Lenz (1941—42, p. 347) points out that a characteristic occurring with 100 per cent concordance in *IT* and with little frequency of concordance in *FT*, need not necessarily be dependent on heredity, as pre-natal environmental factors may in a given case be assumed to work in the same way in *IT*, and in a different way in *FT*. Thus it is probable that the so-called mongoloid idiocy is not hereditary, but may be brought about by a damage of the plasm of the unfertilized ovum, although in respect to this disease *IT* are always concordant, whereas *FT* are, as a rule, discordant. In this case the concordance is due to the damage of the plasm of the unfertilized ovum from which the two *IT*-embryos are to be derived, not to the identity of genotype in the twins.

— Another objection is that *IT* and *FT* do not always behave alike in a test situation.

Gottschaldt (1937, p. 522) maintains that in task and test situations *IT*-partners have a common level of aspiration, requiring from themselves performances and actions judged in the same way, and the same style. They seem to consider their success and failure as being of equal concern to them both. Their way of action in experiments is very often determined by this we-character, we-accent, in each of the *IT*-partners. In comparison with *IT*, the pair-attachment and we-accent in *FT*

are considerably less marked; they behave in about the same way as other siblings. These facts are of importance for the methods of genetical-psychological twin investigations.

The influence of an error of this kind has been pointed out by von Bracken (1939), who in an experimental writing competition between twin partners found that *IT*-partners, owing to a "uniforming tendency", approached each other, usually at the expense of the writing speed. *FT*-partners, on the other hand, to some extent showed a "differentiating tendency". This produces what von Bracken has called *the second social-psychological source of error*, working in an opposite direction of his first social-psychological source of error which is due to the division of roles.

Legrün (1938, p. 715) points to the conscious or unconscious tendency of twins to make their handwriting more alike or more different than would have been the case if they had not been influenced by one another. As this feature need not be equally prominent in *IT* and *FT*, it may be a source of error in a comparison of *IT* and *FT* in the field of handwriting.

— Thus we find that the comparability of the compared *IT* and *FT* groups may be disturbed by a number of sources of error, either diminishing or increasing the difference between *IT*-partners as compared with *FT*.

Of the sources of error which may be assumed to *diminish* the intra-pair difference of *IT* as compared with *FT*, the following are the most important:

A. Owing to a considerably greater physical and mental resemblance between the partners, *IT* on an average will meet a smaller intra-pair difference in the objective environment than *FT*, the greater resemblance in *IT* bringing out the following results:

1. There will generally be a closer attachment between *IT*-partners than *FT*-partners, and, consequently, there is greater probability of their experiences being less different, owing to the fact that a) they are more together (cp. von Bracken, 1934 a; Lehtovaara, 1938), b) they less frequently seek different environments (cp. von Hofsten, Bleuler, Wilson), and c) they have more mutual friends (cp. von Bracken, 1934 a; Lehtovaara, 1938; Östlyngen, 1946).

2. *IT*-partners will be treated more alike by parents and other persons than *FT*-partners (Lunde's argument 1). The surroundings react in a more similar manner on persons who are very much alike, than on persons who look less alike or who are very different of appearance (cp. also cases of mistaken identity).

3. Each member of an *IT*-pair will have a twin partner mentally and physically much more like himself, or herself, than is the case with *FT* (cp. Poll).

B. *An objectively identical environmental influence which is subjectively experienced more or less differently by individuals deviating from each other, will be experienced more differently — and have a more different effect — by FT-partners than by IT-partners*, because *FT*-partners physically and mentally differ considerably more from each other than do *IT*-partners. The more psycho-physically different two individuals are, the more different will be the effect of identical influences (Lunde's argument 3). Likewise the same objective environmental difference for twin partners will subjectively mean a greater difference to *FT* than to *IT*.

C. *IT-partners sometimes consciously or unconsciously strive at being alike, whereas FT-partners not infrequently consciously or unconsciously strive at being different*. These tendencies may have various backgrounds:

1. *IT-partners* wish to be as like each other as possible.

2. The parents and acquaintances of *IT*-partners wish them to be as alike as possible, and encourage them to appear as alike as possible (Lunde's argument 2), and even to imitate each other.

3. Owing to the closer attachment between *IT*-partners, they will identify themselves with each other to a larger extent than *FT*-partners ("we-accent" in *IT*). Likewise, the mutual influence is stronger in *IT*. In psychoses there may be an inductive effect in *IT* (Hartmann).

4. For the same reason a uniforming tendency is at work in *IT*, whereas rivalry, compensation, and a differentiating tendency are more frequent in *FT*. This may partly cause lasting effects, partly influence test situations (von Bracken's second social-psychological source of error).

D. *When IT are judged by others (e.g. in school performance), actual differences may not come to light owing to a halo effect caused by their great resemblance (cp. Lehtovaara 1938, p. 138).*

E. *The expectation of twins being alike may cause particular attention to be paid to the great differences often found between FT-partners (cp. Lassen 1931).*

Sources of error that may be assumed to *enlarge* the intra-pair difference of IT as compared with that of FT, are the following:

F. *Mutual pre-natal influence of the twin partners:* There will generally be a stronger mutual influence during the intra-uterine development of IT than of FT, owing partly to the greater pressure arising from the fact that IT often have a common chorion and sometimes also the same amnion, partly to nourishment, as the blood circulation in IT may be directly connected, which may be of particular importance for siamese twins. According to Verschuer (1932, p. 171) IT-partners at the time of birth on an average differ at least as much as FT-partners in head shape, body length and weight, which must be due to intra-uterine differentiation (Köhn's first argument; cp. Lenz, 1936, p. 653).

G. *Mutual post-natal adjustment:* In IT perhaps to a greater extent than in FT there occurs a division of roles between the partners, particularly a differentiation into an outwardly-directed and an inwardly-directed partner. (Von Bracken's first social-psychological source of error; cp. Köhn's third argument.)

H. *An attitude of protest in IT resulting from the tendency of the surroundings to identify the two partners, may cause the twins to strive at being different (cp. Kerr). They will indicate their own individuality (Köhn's second argument).*

I. *IT-partners seem more than FT-partners to have reversed asymmetries.* Thus, in their statistics on twin material Newman, Freeman and Holzinger (1937, p. 50) have entered all items that could be interpreted as exhibiting complete or partial asymmetry reversal, and they found that out of 275 separate items involving reserved asymmetry, 180 (about 65 per cent) were found in IT and 95 (about 35 per cent) in FT. They take this to mean that a considerable amount of asymmetry reversal, particularly partial, occurs as a concomitant of monozygotic twinning. Asymmetry reversal may then cause further differences between IT-

partners. As stated by Dahlberg, an asymmetrically occurring characteristic may manifest itself only in one of the twin partners, in the same way as the characteristic may find expression in only one body half of an individual.

J. *Errors of measurement are relatively more important in IT than in FT when the intra-pair difference of IT is less than that of FT and is of about the same order of magnitude as the errors of measurement* (Lenz 1932). In like persons they may cause a difference in the results, whereas in persons of unlike heredity they will more or less cancel each other.

K. *Contrast effect*: The greater resemblance there is between the twins, the more easily are possible differences observed (cp. von Bracken 1936 a, p. 78).

Each of these sources of error (A—K) does not probably amount to much, but together they are of considerable importance. Owing to them the assumption of the comparability of *IT* and *FT* can no longer be considered as being fully valid. Thus there is no denying the fact that *IT*-partners on an average are subject to more similar environmental influences than are *FT*-partners, and even if — as pointed out by for instance Stumpfl (1939, p. 380) and Gottschaldt (1942 a, p. 119) — it is the genotypical identity which is the real basis of this fact, it means a serious source of error in comparisons of *IT* and *FT*, making conclusions based on such comparisons more or less doubtful. It is probable that a number of the other sources of error indicated are also at work, but little has been done to ascertain the degree of the influence of them. However, the first source of error is so serious that the method is rendered more or less inapplicable. This is especially the case in the field of psychology, and concerns the environmentally determined characteristics more than the genotypically determined characteristics. This source of error is also at work on related phenomena as criminality and psychoses, but not, or very little, in the somatic field. A critical attitude is therefore justified towards conclusions about the importance of heredity in the development of mental characteristics, criminality, and psychoses on the ground of comparisons between *IT* and *FT*, especially when the difference is not very great. One is also justified in adopting a critical attitude to investigations on the inheritability of infectious diseases based on comparisons of *IT*

and *FT*. Apart from the possibility that a special, inherited disposition may assert itself, *IT* will be likely to have a higher concordance than *FT*, for the following reasons:

1. *IT*-partners are averagely more together, and accordingly, there is greater probability of a) simultaneous infection from the same source, b) mutual infection, especially in the incubation period.

2. *IT*-partners are averagely more alike with regard to general health, and for that reason their power of resistance against infection will probably also be more alike.

One has to look with scepticism upon all attempts to express in numeric proportions the relative importance of heredity and environment. Of these attempts the methods of Wilde and Dahlberg probably deserve the greatest attention, but even their methods are based on the assumption that heredity and environment are independent variables, and we know that this is not always the case. To a considerable extent, the environment that an individual will get, depends on the heredity of that individual, and the heredity that will manifest itself, is not infrequently dependent on the environment of the individual. In other words, the two groups of factors are very often due to close inter-relationship.

Further, the relation between mD_{FT} and mD_{IT} depends, as Lenz has pointed out, on the heterogeneity of the population with regard to the given characteristic. In an isogene population mD_{FT} is not greater than mD_{IT} . Even the difference found between *FT*-partners will then be determined by environment. According to the formulas for calculating the shares of heredity and environment the share of environment would seem to be 100 per cent, but it is obvious that a characteristic, for example eye colour, is as much determined by heredity in a population with one eye colour as in a population which is hereditarily very heterogeneous as regards the given characteristic.

Apart from mass statistical comparisons of intra-pair differences in *IT* and *FT*, scientists sometimes make use of comparisons of other groups of twins. Sources of error seem to be possible even in these comparisons.

With regard to comparisons of *IT* reared together and *IT* reared apart for the purpose of throwing light on the importance

of the environmental background, the difference in the social-psychological conditions may produce a source of error. Between *IT*-partners reared together there are strong mutual influences which may result partly in a convergent, partly in a divergent development. In *IT*-partners reared together a division of functions is likely to take place, which may produce a difference between them. In the case of *IT*-partners reared apart there will naturally be no such mutual influence and division of functions.

In co-twin control experiments, a source of error may arise from the fact that *IT*-partners are not quite identical at the beginning of the experiments. A difference of weight, reversed asymmetries, a lasting injury in the one partner caused perhaps by natal trauma, and so on, may cause the conditions of learning to be different in the two partners during the experiment. Such a source of error is particularly likely to assert itself in experiments to a single twin pair, as in those made by Gesell and his collaborators.

5. *Conclusions from a twin material to the whole population.*

Von Bracken (1936b) suggests that the mere fact of being a twin is a special factor of great importance in the subjective world of twins. For this reason one should be careful in concluding from the psychological conditions of twins to the corresponding conditions of single-born persons.

Conclusions from conditions among twins to conditions in a population of mainly single-born persons, probably often is valid, but hardly always. Twins as a group differ in some directions from single-born persons. Thus, twins differ from their own brothers and sisters in the following ways:

1. Twins are of the same age; other siblings differ more or less in age. Therefore twins will be treated in a more alike manner and have more alike conditions of development.

2. Twins are smaller and weaker at birth, partly because they are generally born too early, partly because they are two to compete for nourishment from the mother. This causes, among other things, a greater rate of birth and infant deaths among twins, and more frequent haemorrhages in the central nervous system (especially in the case of breech presentation).

3. Twins are more together and there is greater probability of their experiences being alike.

4. Twins are treated more alike; they generally wear like clothes, they have the same toys, receive the same food, etc.

5. Mutual concord, attachment and dependence are greater in twins, especially *IT*, than in single-born siblings. Therefore they have generally fewer other intimate friends. In general they have a feeling of unity.

6. Between twins, especially between *IT*-partners, there is often a division of labour and roles.

7. People generally react in a particular way to twins, especially to *IT*: a) *IT* generally attract attention when they are out together. b) *IT* very often hear allusions to their great resemblance, whereas *FT* sometimes hear allusions to the fact that they are different despite their being twins. c) *IT* are constantly being compared, physically and mentally. d) *IT* are generally identified and looked upon as a unity. e) *IT*-partners are often confused.

8. Considered as a group, twins differ in certain physical and mental features from single-born persons; thus asymmetry reversal is probably more frequent in them.

One cannot therefore expect that a twin material, with regard to physical, mental, and social characteristics, will be quite representative of the population in general. This may diminish the significance of twin research for non-twin problems.

As for the *variability* among twins, it differs considerably from the variability in the whole population. In the first place, both *IT* and *FT*, but particularly the former, have not only a more similar environment than two same-sexed persons picked by chance, but even a more similar environment than ordinary same-sexed siblings. Secondly, the difference of heredity between not related same-sexed persons is considerably greater than that between *FT*-partners. Therefore one cannot conclude from the dependence on heredity and environment of twin differences to the dependence on heredity and environment of differences found in the population in general.

For the same reason one may also have doubts about the value of the so-called "manifestation probability" which by means of certain formulas has been calculated for a number of anomalies and diseases, on the basis of the frequency of concordance and

discordance in *IT*. The figure has been calculated on the basis of an *IT*-material, and its validity is limited to the probability within an *IT*-material or within a population where the environmental differences found among individuals belong to the same order of magnitude as those found between *IT*-partners. Since the average environmental differences in a population are greater — considerably greater probably — than those found between *IT*-partners, the manifestation probability is less for people in general. The frequency of concordance, therefore, does not make it possible to compute the probability of manifestation of a given characteristic for an individual carrying the hereditary character, but only the probability of a given characteristic manifesting itself in an *IT*-partner when it has manifested itself in the other partner. And this is valid only on condition that the twins live as much together as was the case in the *IT*-material on which the calculations were based.

Moreover, the supposition that the probability of manifestation and latency in the two partners combines binomially in *IT* does not always seem to hold good. It is based on the assumption that the manifestation or latency in the two partners are mutually independent, but it is doubtful whether such an independence is the rule. If the uncertainty of manifestation is determined by environmental factors, the similarity of twin environment may result in a smaller percentage of discordance than according to a binomial distribution. Before we can reckon with a binomial distribution of twin partners with manifest and latent characteristic, it must be ascertained that environmental factors, which twins reared together have *more* in common than unrelated pairs of individuals, do not influence the manifestation of the characteristic in question. This may perhaps be the case with, say, polydactyly, but not with tuberculosis and criminality (cp. contagion and criminal influence). If it turns out not to be the case with the characteristic in question, it is in other words impossible to calculate the number of negative concordant pairs from the number of positive-concordant and discordant pairs.

III. *Conclusions.*

Twin research has been used in attempts to throw light on problems of heredity and environment. The use of a twin ma-

terial for this purpose rests on a number of basic assumptions. Before any conclusions are drawn from a twin material, it is important to make clear whether, or to what extent, these assumptions are valid. The treatment of problems of heredity and environment is hampered by a number of sources of error; this is especially the case in the psychological field. Before drawing conclusions from twin research regarding heredity and environment, it is therefore necessary in each case to discuss, and as far as possible to find out through experiments, whether the assumptions hold good. So far, this has been done only to an inconsiderable extent.

SUMMARY

Twin research is often used to throw light on problems of heredity and environment, such as the relative importance of heredity and environment in creating differences in man, the capacity of environment to produce differences between persons of identical heredity, the probability of manifestation of various hereditary characters, and the relative importance of maturation and training.

This use of twin research, however, rests on five basic assumptions, namely:

1. Twins derived from a single fertilized ovum is of identical heredity, whereas twins developed in other ways is of more or less different heredity.
2. Heredity and environment are the sole factors which can give rise to differences between twin partners, so that differences between twin partners of identical heredity can be ascribed to environmental factors.
3. It is possible to make the differential diagnosis between one-egg and two-egg twins with sufficient certainty.
4. The two groups of twins that are compared are comparable with respect to the matters under investigation.
5. Twins do not differ crucially from single-born persons in the traits under observation.

The objections made by earlier authors to these five assumptions are summarized, and each of them has been thoroughly discussed. It appears that the last two assumptions often do not hold good at all, which strongly limits the validity of twin methods research as a means of solving problems of heredity and environment.

ZUSAMMENFASSUNG

(Die Zwillingsforschung wird oft zur Beleuchtung der Erb- und Umweltprobleme verwendet. Es gibt Probleme wie die relative Bedeutung der Erbanlage und Umwelt für das Entstehen der Unterschiede zwischen den Menschen in allgemein, die Fähigkeit der Umwelt, Unterschiede zwischen erbgleichen Personen zu verursachen, die Manifestationswahrscheinlichkeit

verschiedener Erbanlagen, und die relative Bedeutung der Reifung und des Lernens.

Diese Anwendung der Zwillingsforschung ruht auf fünf Grundvoraussetzungen, nämlich:

1. Zwillinge, die aus nur einem befruchteten und später gespaltenen Ei stammen, sind erbgleich, jedoch Zwillinge, die anderswie entstanden sind, mehr oder weniger erbverschieden.
2. Erbe und Umwelt sind die einzigen Faktoren, die Unterschiede zwischen den Zwillingspaaren verursachen können, so dass Unterschiede zwischen erbgleichen Zwillingspaaren nur Umweltfaktoren zugeschrieben werden können.
3. Die Differenzialdiagnose zwischen eineiigen und zweieiigen Zwillingen kann in der Praxis mit hinreichend grosser Sicherheit gestellt werden.
4. Die zwei Gruppen von Zwillingen, die verglichen werden, sind vergleichbar in Bezug auf die untersuchten Verhältnisse.
5. Zwillinge unterscheiden sich in den untersuchten Zügen nicht wesentlich von Einlingen.

Die Einwendungen, die frühere Verfasser gegen diese fünf Voraussetzungen gemacht haben, werden ausführlich besprochen. Es zeigt sich, dass die letzten Voraussetzungen oft gar nicht Stich halten, und dies beeinflusst in hohem Grade die Gültigkeit der Zwillingsmethoden bei Lösung der Erb- und Umweltprobleme.

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- Acta PtN** Acta psychiatrica et neurologica. København.
- ArGsPs** Archiv für die gesamte Psychologie. Leipzig.
- ArRaBi** Archiv für Rassen- und Gesellschaftsbiologie. München.
- BerKgDGesPs** Bericht über den... Kongress der Deutschen Gesellschaft für Psychologie. Jena.
- BrJPs** British Journal of Psychology. General section. Cambridge.
- ChPers** Character and Personality. London.
- DMdW** Deutsche medizinische Wochenschrift. Leipzig.
- GenetPsMon** Genetic Psychology Monographs. Worcester. Mass.
- JbPt** Jahrbücher für Psychiatrie und Neurologie. Wien.
- JEdPs** Journal of Educational Psychology. Baltimore.
- NordMd** Nordisk medicin. Stockholm.
- NordMdT** Nordisk Medicinskt Tidsskrift. Helsingfors.
- PtNW** Psychiatrisch-neurologische Wochenschrift. Halle.
- ZAbst** Zeitschrift für induktive Abstammungs- und Vererbungslehre. Leipzig.
- ZAngPs** Zeitschrift für angewandte Psychologie. Leipzig.
- ZKonst** Zeitschrift für menschliche Vererbungs- und Konstitutionslehre. Berlin.
- ZNPt** Zeitschrift für die gesamte Neurologie und Psychiatrie. Berlin.
- ZPdPs** Zeitschrift für pädagogische Psychologie. Leipzig.

DIE ANALYSE DES PHÄNOMENALEN KONTINUUMS

EIN BEITRAG ZU EINER SYNTHETISCHEN PSYCHOLOGIE DER GANZEN

von

OTTO SELZ¹⁾

Inhalt:

- § 1. Mengenphänomene und Reihenphänomene.
- § 2. Das allgemeine Bildungsgesetz der Reihenphänomene.
- § 3. Zur psychologischen Klassifikation der Stellenphänomene und der Ordnungszahlen.
- § 4. Das allgemeine Bildungsgesetz der phänomenalen Kontinuen.
- § 5. Das Bildungsgesetz des Vollkontinuums und der Vollreihe.
- § 6. Die angebliche Unzurückführbarkeit der Ausdehnung.
- § 7. Der Uebergang durch unmerklich verschiedene Zwischenstufen und das phänomenale Kontinuum.
- § 8. Das Aufbauprinzip der stetigen Gradsteigerung.

§ 1. Mengenphänomene und Reihenphänomene.

Die synthetische Psychologie der Ganzen unterscheidet sich von den älteren Versuchen einer synthetischen Psychologie, die theoretisch nur eine Grundklasse von Wahrnehmungsphänomenen, die Empfindungsqualitäten, kennen, durch die *Einführung einer zweiten Grundklasse, der phänomenalen*

¹⁾ Als Otto Selz, einer der bedeutendsten Psychologen der Gegenwart, gezwungen war seine Lehrtätigkeit in Deutschland einzustellen, kam er auf meine Einladung nach Amsterdam, wo er seine wissenschaftliche Arbeit fortsetzte, bis er eines Tages von der deutschen Polizei von seiner Wohnung abgeholt, sofort nach Polen verschickt wurde, wo er umgekommen ist. Die hier veröffentlichte Studie ist seine letzte Arbeit, die er trotz der grössten Gefahr, mit der grössten Hingabe ausführte. Seine ganze wissenschaftliche Persönlichkeit, seine leidenschaftliche und unerschütterliche Liebe zur Wahrheit, sein Streben, die prinzipiellen Fragen bis in ihre tiefsten Gründe zu verfolgen, kommt in dieser vorzüglichen, in ihrer Bedeutung weit über die Grenzen der Psychologie hinausgehenden Arbeit zum Ausdruck.

*Verbindungsweisen der Qualitäten*²⁾. Die phänomenalen Verbindungsweisen sind die letzten Aufbauprinzipien der phänomenalen Ganzen. Ihre systematische Analyse ermöglicht die *adäquate Beschreibung der phänomenalen Ganzen durch ihr Bildungsgesetz* und damit den bisher vergeblich versuchten Rückweg von der Analyse der Ganzen zu ihrer synthetischen Darstellung.

Das einfachste Bildungsgesetz von phänomenalen Ganzen ist das *allgemeine Bildungsgesetz der Mengenphänomene*³⁾. Es beruht auf einem einzigen Aufbauprinzip der phänomenalen Verbindungsweise der Wiederholung. Seine symbolische Formel ist:

$$1 + 1 + 1 + 1 + 1 \dots\dots\dots (1),$$

wobei 1 die sich als „Einheiten“ diskret wiederholenden Qualitäten, Qualitätsmomente oder Ganzen aus solchen und das Pluszeichen ihre Verbindung durch das Wiederholungsphänomen bezeichnet. Mit jeder Wiederholung nimmt die Grösse der Anzahl einer Menge zu, gleichgültig, ob ihre Einheiten, d.h. das, was sich in ihr wiederholt, zeitlich oder räumlich einander folgen. Die sonach auf dem Aufbauprinzip der diskreten Wiederholung beruhende Grösse der Anzahl ist die spezifische Ganzeigenschaft, hinsichtlich deren die Mengenphänomene variieren. Hierbei verstehen wir unter Ganzeigenschaften solche Eigenschaften der vermöge der phänomenalen Verbindungsweisen der Qualitäten aufgebauten Ganzen, welche den aufbauenden Qualitäten noch nicht zukommen.

Wir bezeichnen die Phänomene der Zunahme bzw. Abnahme der Grösse oder des Grades als positive bzw. negative *Steigerungsphänomene*. Da mit jeder Wiederholung die Grösse der Anzahl zunimmt, ist die phänomenale Verbindungsweise der Wiederholung also ein Steigerungsphänomen; und zwar ist das Aufbauprinzip der Wiederholung das Prinzip der *immanenten Grössensteigerung*, das die Ganzeigenschaft der Grösse und bei

²⁾ Die allgemeinen Grundlagen einer synthetischen Psychologie der Ganzen wurden in zwei früheren Beiträgen dargelegt: 1. Die Aufbauprinzipien der phänomenalen Welt, Acta Psychologica, herausg. von G. Révész, Band V, Heft 4; 2. Die phänomenalen Grundlagen des Zahlbegriffs, Nederlandsch Tijdschrift voor Psychologie, Jaarg. IX S. 147 ff. im folgenden als Beitrag 1 bzw. 2 bezeichnet.

³⁾ Siehe die ausführliche Behandlung der Mengenphänomene in Beitrag 2.

diskreter Wiederholung die Grösse der Anzahl erst aufbaut. Von dieser immanenten Grössensteigerung ist die *transeunte* Grössensteigerung zu unterscheiden, die von Grösse zu Grösse, also zwischen Wiederholungsstrukturen, stattfindet und daher die immanente Grössensteigerung voraussetzt.

Die Qualitäten der Empfindung und zwar sowohl die Sinnesqualitäten im engeren Sinne wie die räumlichen und zeitlichen Lagequalitäten bilden stetig abgestufte und deshalb graduell abgestufte Systeme. Sie können infolgedessen durch die beiden phänomenalen Verbindungsweisen der Wiederholung und der stetigen oder sprunghaften Gradsteigerung miteinander in Verbindung treten. Wiederholung als immanente Grössensteigerung und Gradsteigerung sind die beiden Grundarten der phänomenalen Verbindungsweisen der Qualitäten, die die Ganzen aufbauen. Demnach gehören alle phänomenalen Verbindungsweisen der Qualitäten zu phänomenalen Ganzen derselben *allgemeinen Klasse der Steigerungsphänomene* an.

Beim Aufbauprinzip der Wiederholung schreitet die erlebte immanente Grössensteigerung von der jeweiligen Ausgangsqualität zu immer zusammengesetzteren Ganzen fort, während von Qualität zu Qualität keine Steigerung stattfindet. Die Gradsteigerung dagegen findet von Qualität zu Qualität und die transeunte Grössensteigerung von Grösse zu Grösse statt. Wie nun die durch Wiederholung erzeugte immanente Grössensteigerung die Mengenphänomene und ihre Ganzeigenschaft der Anzahlgrösse aufbaut, so bauen Gradsteigerung und transeunte Grössensteigerung durch ihre von Aufbauelement zu Aufbauelement des Ganzen fortschreitende Steigerung die Reihenphänomene und ihre spezifische Ganzeigenschaft der Ordnung auf. Wir können die von Aufbauelement zu Aufbauelement eines Ganzen fortschreitende Steigerung im Gegensatz zu der vom Aufbauelement zu immer zusammengesetzteren Ganzen fortschreitenden immanenten Grössensteigerung auch allgemein als *transeunte Steigerung* bezeichnen. Die beiden Arten der transeunten Steigerung, die Gradsteigerung und die transeunte Grössensteigerung, sind hiernach die *Aufbauprinzipien der phänomenalen Ordnung* und der durch diese spezifische Ganzeigenschaften ausgezeichneten *Reihenphänomene*. Die phänomenale Ordnung von *Qualitäten* beruht ausschliesslich auf dem Aufbauprinzip der Gradsteigerung.

§ 2. Das allgemeine Bildungsgesetz der Reihenphänomene.

Man kann das in Formel 1 ausgedrückte Bildungsgesetz der Mengenphänomene kurz das *Aufbaugesetz der fortgesetzten Wiederholung* nennen. Das allgemeine Bildungsgesetz der Reihenphänomene lässt sich dann kurz als das *Aufbaugesetz der fortgesetzten Steigerung* bezeichnen. Unter Steigerung ist dabei die Steigerung von Aufbauelement zu Aufbauelement, also die transeunte Steigerung zu verstehen. Sie kann positiv oder negativ, also Zunahme oder Abnahme, Gradsteigerung oder Grössensteigerung, stetig oder sprunghaft sein. Nur muss sich, damit ein Reihenphänomen entsteht, von Aufbauelement zu Aufbauelement dasselbe Steigerungsphänomen wiederholen. Wir wollen die Verbindung der Aufbauelemente durch ein konstant bleibendes Steigerungsphänomen symbolisch durch das Zeichen $<$ ausdrücken, das die mathematische Mengenlehre für die „Ordnungsbeziehungen“ (d.i. die Ordnung konstituierende Beziehung) verwendet. Bezeichnen wir die Aufbauelemente oder „Glieder“ einer Reihe mit a_1, a_2, a_3 , usw., so ergibt sich für das allgemeine Bildungsgesetz der Reihenphänomene sonach die Formel:

$$a_1 < a_2 < a_3 < a_4 < a_5 \dots \dots \dots (2)$$

Diese Formel befasst dann sowohl die Reihen mit positiver Steigerung, die steigenden Reihen, (z.B. von Tonhöhen oder Lautheitsgraden):

$$a_1 < a_2 < a_3 < a_4 < a_5 \dots \dots \dots (3)$$

wie die Reihen mit negativer Steigerung, die fallenden Reihen, (z.B. von fallenden Tonhöhen oder abnehmenden Lautheitsgraden):

$$a_1 > a_2 > a_3 > a_4 > a_5 \dots \dots \dots (4)$$

Bei der Analyse des allgemeinen Bildungsgesetzes der Reihen beschränken wir uns zunächst in erster Linie auf die Reihenphänomene im engeren Sinne, die diskreten Reihen. Die Besonderheiten der stetigen Reihen, der phänomenalen Kontinuen, werden wir später behandeln.

Nach dem allgemeinen Bildungsgesetz der fortgesetzten Steigerung ist jedes Reihenphänomen durch zwei Aufbauprinzipien

und demgemäss auch allgemein durch zwei von diesen konstituierte Ganzeigenschaften gekennzeichnet. Jede Reihe der Grössensteigerung baut sich aus Grössen, jede Reihe der Gradsteigerung aus Gradabstufungen einer und derselben Qualität (z.B. der Tonhöhe, Lautheit, Schwere) auf; jedes Reihenphänomen im engeren Sinne ist daher zugleich eine *diskrete Wiederholungsstruktur*. In der Formel ist dies durch die Wiederholung des Buchstaben *a* mit fortschreitendem Index angedeutet. Als diskrete Wiederholungsstruktur teilt die Reihe oder „geordnete Menge“ mit den Mengenphänomenen im engeren Sinne die Ganzeigenschaft der Grösse der Anzahl. Das zweite Aufbauprinzip, die phänomenale Verbindungsweise der Gradsteigerung oder transeunten Grössensteigerung, fügt dann der Ganzeigenschaft der Grösse die den Reihen eigentümliche Ganzeigenschaft der Ordnung hinzu.

Dass die transeunten Steigerungsphänomene als phänomenale Ordnungsstifter fungieren, erklärt sich aus ihren Eigenschaften. Ihnen nämlich kommen die beiden Eigenschaften zu, welche die mathematische Mengenlehre für die Erzeugung einer „Ordnungsbeziehung“ als notwendig erkannt hat, die *Transitivität* und die *Asymmetrie*⁴⁾. Steigerungsphänomene sind erstens transitiv (übergehend): Findet von *a* zu *b* und von *b* zu *c* eine Grössenzunahme (Grössenabnahme) statt, so findet auch von *a* zu *c* eine Grössenzunahme (Grössenabnahme) statt. Findet bei der Gradsteigerung beispielsweise von *a* zu *b* und von *b* zu *c* eine Schwerezunahme (Schwereabnahme) statt, so findet auch von *a* zu *c* eine Schwerezunahme (Schwereabnahme) statt. Findet von *a* zu *b* und von *b* zu *c* stetige Gradsteigerung statt, so findet auch von *a* zu *c* stetige Gradsteigerung statt. Allgemein: Aus $a < b$ und $b < c$ folgt $a < c$, d.h. findet von *a* zu *b* und von *b* zu *c* irgend ein konstant bleibendes Steigerungsphänomen statt, so findet ein gleichartiges Steigerungsphänomen auch von *a* zu *c* statt. Ein Unterschied besteht nur hinsichtlich der Grösse der Steigerung, die mit der Anzahl der durchlaufenen oder übersprungenen Zwischenglieder einer Reihe wächst. Infolge der Transitivität der Steigerungsphänomene folgt aus

⁴⁾ Vgl. A. Fraenkel, Einleitung in die Mengenlehre, 3. Aufl. (Berlin 1928), 3. Kapitel; B. Russell, Einführung in die mathematische Philosophie (München 1923) 4. Kapitel.

dem allgemeinen Bildungsgesetz der Reihenphänomene $a_1 < a_2 < a_3 < a_4 < a_5 \dots\dots\dots$, dass auch $a_1 > a_3$, $a_1 < a_4$, $a_1 < a_5$ usw. gilt, sodass von a_1 , zu allen Gliedern der Reihe dasselbe, nur der Grösse nach variierende Steigerungsphänomen stattfindet.

Das Phänomen der fortgesetzten Wiederholung in einer Menge lässt sich sprachlich am besten durch das „eins, noch eins, noch eins“ der untersten Stufe des kindlichen Zählens charakterisieren⁵⁾. Entsprechend lässt sich das Phänomen der fortgesetzten transeunten Steigerung in einer Reihe am besten durch das „grösser, noch grösser, noch grösser“, „schwerer, noch schwerer, noch schwerer“, usw. sprachlich kennzeichnen, das auch die Transitivität der Steigerungsphänomene mitausdrückt. In dem Reihenphänomen als dem Phänomen der fortgesetzten Steigerung steckt nämlich nicht nur die *unmittelbare Steigerung* von a zu b und von b zu c , sondern auch die *mittelbare*, d.h. phänomenale Zwischenglieder durchlaufende Steigerung von a zu c . Durch die Hinzufügung des Wörtchens „noch“ (noch grösser, noch schwerer) wird sowohl die unmittelbare Steigerung von b zu c wie die mittelbare von a zu c sprachlich zum Ausdruck gebracht. Infolge der Transitivität der Steigerungsphänomene enthält das Phänomen einer Reihe von n Gliedern das Erlebnis einer mittelbaren (positiven oder negativen) Steigerung von a_1 bis a_n . Die Grösse der mittelbaren Steigerung erreicht hierbei im n 'ten Glied ihr jeweiliges Maximum, ein Phänomen, das die Sprache durch den Superlativ (das grösste bzw. kleinste, das schwerste bzw. leichteste) ausdrückt. Die von der Sprache gebrauchten Komparative und Superlative sind die zuverlässigen Anzeigen dafür, dass die phänomenalen Reihen Steigerungsphänomene sind. Während der Komparativ auf ein Steigerungsphänomen hinweist, zeigt der mit dem Zusatz „noch“ gebrauchte Komparativ und der Superlativ die fortgesetzte Steigerung, also ein Reihenphänomen an.

Die Transitivität der Steigerungsphänomene ist eine notwendige, aber keine hinreichende Bedingung für den Aufbau der Ganzzeigenschaft der Ordnung; denn Transitivität kommt auch den Gleichheitsphänomenen der Wiederholungsstrukturen zu, die keine Ordnung zu erzeugen vermögen. Aus $a = b$ und

⁵⁾ Siehe Beitrag 2 § 18.

$b = c$ folgt $a = c$. Damit phänomenale Ordnung entstehen kann, muss zu der Transitivität zweitens die den transeunten Steigerungsphänomenen eigentümliche Asymmetrie hinzukommen. Wiederholungsphänomene sind symmetrisch, d.h. es findet von a zu b und von b zu a dieselbe phänomenale Verbindungsweise der Wiederholung statt. Aus $a = b$ folgt daher $b = a$. Transeunte Steigerungsphänomene sind dagegen asymmetrisch, d.h. es findet von a zu b und von b zu a nicht dieselbe phänomenale Verbindungsweise statt: Ist a grösser als b , so ist b kleiner als a . Ist a schwerer als b , so ist b leichter als a . Ist a früher als b (Zunahme des Vergangenheitsgrades in Richtung auf a), so ist b später als a (Abnahme des Vergangenheitsgrades in Richtung auf b). Liegt a räumlich höher als b , (also mehr oben), so liegt b niedriger als a (also mehr unten). Allgemein: Aus $a < b$ folgt $b > a$, wobei das Zeichen $>$ die Umkehr (Inversion) des Steigerungsphänomens ausdrückt. Hierbei wird ein positives Vorzeichen der Steigerung in ein negatives bzw. ein negatives in ein positives verwandelt, oder die Richtung, in der die Steigerung stattfindet, geht in ihre Gegenrichtung über.

Die Symmetrie der Wiederholungsphänomene begründet die *Funktionsgleichheit* ihrer Aufbauelemente. Von a nach b und von b nach a findet ja dasselbe Wiederholungsphänomen statt. Wir können daher in einem Wiederholungsphänomen die Glieder miteinander vertauschen, ohne dass sich an dem Wiederholungsphänomen selbst etwas ändert. Infolge der Symmetrie der Wiederholungsphänomene bleibt in einer Menge ihreanzeigenschaft, die Anzahl, auch erhalten, wenn ihre Aufbauelemente beliebig miteinander vertauscht werden. Sie erfüllen alle die gleiche Funktion, durch ihre Wiederholung als „Einheiten“ die Anzahl mit aufzubauen.

Die Asymmetrie der transeunten Steigerungsphänomene begründet dagegen die *Funktionsungleichheit* ihrer Aufbauelemente. Vertausche ich in einem einfachen Steigerungsphänomen $a < b$ die Aufbauelemente, so findet eine Inversion des Steigerungsphänomens statt. Für den Aufbau eines transeunten Steigerungsphänomens ist es also nicht gleichgültig, ob die Steigerung von einem Aufbauelement ausgeht oder zu ihm hinführt, ob es Ausgangsglied oder Endglied der Steigerung ist. Es verändert je nachdem seine Aufbaufunktion. Ist z.B. im Falle der Gradsteigerung der höhere Grad Endglied der Steigerung,

so entsteht ein positives Gradsteigerungsphänomen. Ist er dagegen Ausgangsglied der Steigerung, so entsteht ein negatives Gradsteigerungsphänomen. Jedes Aufbauelement eines transeunten Steigerungsphänomens nimmt somit infolge seiner Asymmetrie einen bestimmten Platz, eine „Stelle“, in ihm ein, die nicht geändert werden kann, ohne dass das Steigerungsphänomen selbst sich mitändert.

Wir wollen das Aufbauelement, dass das Ausgangsglied eines transeunten Steigerungsphänomens bildet, als „Vorgänger“, das Aufbauelement, dass das Endglied bildet, als „Nachfolger“ bezeichnen ⁶⁾. In dem fortgesetzten Steigerungsphänomen einer Reihe wird nach ihrem allgemeinen Bildungsgesetz der Nachfolger wieder Vorgänger eines Nachfolgers, dieser wieder Vorgänger eines weiteren Nachfolgers in der alle Reihenglieder durchlaufenden Steigerung. Wir können also die Aufbauelemente einer Reihe nach ihrer Stelle in ihr als Vorgänger, Nachfolger, Nachfolger des Nachfolgers, Nachfolger des Nachfolgers des Nachfolgers usw. bezeichnen. Die *Ganzeigenschaft der Ordnung* einer phänomenalen Reihe besteht darin, dass ihre Aufbauelemente so miteinander verbunden sind, dass ein fortgesetztes Steigerungsphänomen entsteht, in dem sie in der soeben definierten Weise einander „nachfolgen“ (als das jeweils schwerere oder leichtere, grössere oder kleinere, frühere oder spätere, höhere oder niederere). Für die Stellen, die die Aufbauelemente hierbei in der Ordnung einnehmen, gebraucht die Sprache statt der obigen umständlichen Bezeichnungen als Namen die Ordnungszahlen. Sie bezeichnet ausserdem das Aufbauelement einer Reihe, das in dem fortgesetzten Steigerungsphänomen keinen Vorgänger hat, als den „Anfang“ der Reihe, das Aufbauelement, das keinen Nachfolger hat, als das „Ende“ der Reihe und alle anderen Aufbauelemente, die dem Anfangsglied des fortgesetzten Steigerungsphänomens nachfolgen und dem Endglied vorangehen als „zwischen“ ihnen gelegen, also als „Zwischenglieder“ der Reihe. Ein Nachfolger (Vorgänger) der von seinem Nachfolger (Vorgänger) nicht durch Zwischenglieder getrennt ist, heisst „unmittelbarer“ Nachfolger (Vorgänger).

⁶⁾ Die Bezeichnungen „Vorgänger“ und „Nachfolger“ sind in der mathematischen Mengenlehre schon für die Glieder einer „Ordnungsbeziehung“ gebräuchlich.

Es ist in der Asymmetrie der fortgesetzten Steigerungsphänomene strukturgesetzlich begründet, dass diese Phänomene einen Anfang und ein Ende sowie Glieder haben, die „zwischen“ ihnen liegen, ferner dass es ein erstes, zweites, drittes Glied usw. in ihnen gibt, also die diesem allgemeinen Ordnungsschema zugeordneten Ordnungszahlen auf sie anwendbar werden. Die Stellennamen der Ordnungszahlen und die Stellenbezeichnungen „Anfang“, „Ende“, „zwischen“ enthüllen daher erst bei der psychologischen Analyse der Reihenphänomene als Phänomene der fortgesetzten Steigerung ihren anschaulichen, d.h. auf Eigenschaften von Wahrnehmungsphänomenen bezogenen Sinn. Der psychologische Ursprung der Stellenbegriffe einschliesslich der Begriffe der Ordnungszahlen, die sämtlich bisher keinen systematischen Ort und daher kein Heimatrecht in der Psychologie hatten, wird damit geklärt; ebenso wie erst die Analyse der Mengenphänomene als Wiederholungsstrukturen die phänomenalen Grundlagen des numerischen Einheitsbegriffes und der Kardinalzahlbegriffe aufdeckt⁷⁾. „Anfang“, „Ende“, „zwischen“ und die „Ordnungszahlen“ sind Namen für Eigenschaften der Aufbauelemente von Steigerungsphänomenen, die ihnen durch ihre Funktion beim Aufbau einer Reihe zukommen. Diese Stellennamen bestätigen zugleich durch die Art ihrer Anwendung bei der sprachlichen Darstellung einer reihenmässigen Ordnung, ebenso wie die dabei verwendeten Komparative und Superlative unsere Analyse des allgemeinen Bildungsgesetzes der Reihenphänomene und ihrer spezifischen Ganzeigenschaft der Ordnung.

§ 3. *Zur psychologischen Klassifikation der Stellenphänomene und der Ordnungszahlen.*

Von den Ganzeigenschaften sind die *Funktionseigenschaften* der Aufbauelemente zu unterscheiden, die ihnen nur vermöge ihrer Funktion beim Aufbau eines Ganzen zukommen. So ist Einheit im numerischen Sinne eine Funktionseigenschaft, die einer Qualität oder einer Qualitätenverbindung nur insofern zukommt, als sie sich wiederholt und dadurch als Aufbauelement der Ganzeigenschaft der Anzahl fungiert. Auch eine Menge ist als Aufbauelement einer Anzahl eine Einheit. Alle

⁷⁾ Siehe Beitrag 2.

Aufbauelemente einer Anzahl haben dieselbe Funktionseigenschaft, durch ihre Wiederholung „Einheiten“ in ihr darzustellen. Dagegen hat jedes Aufbauelement einer Ordnung seine besondere Funktionseigenschaft, die wir als seine Stelle in der Ordnung bezeichnen. Durch die Stelle, die eine Qualität oder Grösse als erstes, zweites, drittes Glied usw., als Anfangs-End- oder Zwischenglied in einem fortgesetzten Steigerungsphänomen einnimmt, wird sie erst Aufbauelement einer bestimmten Ordnung.

Wie die Ganzeigenschaft der Anzahl verdankt auch die Funktionseigenschaft eines Aufbauelements, Einheit in einer Menge zu sein, ihre Entstehung der phänomenalen Verbindungsweise der Wiederholung. Ganz entsprechend verdanken die Funktionseigenschaften der Aufbauelemente einer Ordnung, die durch die Ordnungszahlen und die Stellennamen Anfang, Ende, zwischen bezeichnet werden, ihre Entstehung den phänomenalen Verbindungsweisen der Gradsteigerung und der transeunten Grössensteigerung. Ohne die phänomenalen Verbindungsweisen der transeunten Steigerung gäbe es auch keine Stellenphänomene und keine Ordnungszahlen. Nicht nur die Ganzeigenschaften, sondern auch die Funktionseigenschaften der Aufbauelemente der Ganzen verdanken also ihre Entstehung den phänomenalen Verbindungsweisen. Sowohl die phänomenalen Grundlagen der Kardinalzahlbegriffe wie die der Ordnungszahlbegriffe liegen daher in den phänomenalen Verbindungsweisen.

§ 4. *Das allgemeine Bildungsgesetz der phänomenalen Kontinuen.*

Alle phänomenalen Kontinuen sind *Reihenphänomene* (im Sinne von Formel 2) mit dem spezifischen Aufbauprinzip der stetigen Gradsteigerung. Wir können 4 Hauptarten der phänomenalen Kontinuen unterscheiden:

- 1) die *räumlichen Kontinuen*, die hinsichtlich ihrer Grösse nach der räumlichen Ausdehnung variieren,
- 2) die *zeitlichen Kontinuen*, die nach der Grösse der zeitlichen Ausdehnung oder Dauer variieren,
- 3) die *Intensitätskontinuen*, wie sie bei stetiger Variation des Stärkegrades einer Qualität, z.B. beim Anschwellen oder Abschwellen der Stärke eines Tones entstehen,

4) die *Qualitätenkontinuen* (im engeren Sinne), wie sie bei stetiger Variation des Qualitätstones, z.B. bei stetiger Zunahme oder Abnahme der Tonhöhe oder bei stetiger Variation des Farbtones zustandekommen.

Allen vier Hauptarten ist die *spezifische Ganzeigenschaft der Kontinuen*, der *ununterbrochene phänomenale Zusammenhang*, gemeinsam. Dieser aber beruht überall auf demselben Aufbauprinzip der stetigen Gradsteigerung, gleichgültig, ob es sich um den ununterbrochenen räumlichen oder zeitlichen Zusammenhang, um die stetige Variation der Qualität (im engeren Sinne) oder die der Intensität handelt. Ebenso wie die kontinuierliche Zunahme oder Abnahme des Stärkegrades einer Qualität beruht auch die Kontinuität einer Reihe ähnlicher Qualitäten sowie das kontinuierliche räumliche Nebeneinander und zeitliche Nacheinander auf den Phänomenen der stetigen Gradsteigerung. So beruht die Kontinuität der Dauer, die wir in der stets rückschauenden Zeitwahrnehmung erleben, auf der stetigen Abnahme des Vergangenheitsgrades in der qualitativen Erfüllung des Zeitfeldes. Während die sprunghafte Abnahme des Vergangenheitsgrades (z.B. von Ton zu Ton) das Phänomen der diskreten „*Zeitfolge*“ begründet, begründet die stetige Abnahme des Vergangenheitsgrades (z.B. in einem konstant ausgehaltenen Ton) das Phänomen der kontinuierlichen „*Dauer*“.

Auf dem räumlichen Gebiet beruht die Kontinuität einer *Vertikalen* auf der stetigen Gradsteigerung des räumlichen Höhengrades (der Gradabstufungen des Oben und Unten); die Kontinuität einer *Horizontalen* auf der stetigen Gradsteigerung des räumlichen Breitengrades (der Gradabstufungen des Rechts und Links) und die Kontinuität einer geradeaus verlaufenden *Sagittalen* (etwa einer Skispur im Schnee) auf der stetigen Gradsteigerung des räumlichen Tiefengrades (des Grades des Vorn) bei Konstanz des Höhen- und Breitengrades. Die Kontinuität jedes anderen *linearen räumlichen Gebildes* beruht entweder auf der gleichzeitigen stetigen Gradsteigerung aller drei Komponenten der Raumwahrnehmung, des Höhen-, Breiten- und Tiefengrades, oder zweier von ihnen, während die dritte dabei konstant bleibt. So beruht die Kontinuität einer zwischen der Vertikalen und der Horizontalen liegenden *Schrägen* auf der gleichzeitigen stetigen Gradsteigerung des Höhen- und

Breitengrades bei Konstanz des phänomenalen Tiefengrades. Von einer gekrümmten Linie mit gleichzeitiger stetiger Gradsteigerung des Höhen- und Breitengrades unterscheidet sich die Schräge durch die Konstanz des Anteils der Komponenten der Steigerung. Diese verleiht dem linearen Kontinuum die Eigenschaft der Richtungskonstanz und damit der Geradheit.

Die *Kontinuität der zweidimensionalen räumlichen Kontinuen* beruht auf der zweidimensionalen stetigen räumlichen Gradsteigerung. Eine Gradsteigerung ist zweidimensional, wenn ihre Aufbauelemente schon eindimensionale Gradsteigerungsphänomene sind. So ist die „*Flächenbreite*“ eines Rechteckes ein zweidimensionales stetiges Gradsteigerungsphänomen, da sie in seiner ganzen Höhe erlebt wird, die selbst schon ein eindimensionales stetiges Gradsteigerungsphänomen ist. Ebenso ist die „*Flächenhöhe*“ eines Rechteckes ein zweidimensionales stetiges Gradsteigerungsphänomen, da sie in seiner ganzen Breite erlebt wird, die selbst schon ein eindimensionales Gradsteigerungsphänomen darstellt. Gleichgültig also, ob etwa ein „*schlankes Rechteck*“ in seiner ganzen „*Flächenhöhe*“ oder ein langgestrecktes in seiner ganzen „*Flächenbreite*“ als rechteckiges Kontinuum erlebt wird, immer ist das flächenhafte Kontinuum ein zweidimensionales stetiges Gradsteigerungsphänomen.

Auch die Verbindung von Sinnesqualitäten im engeren Sinne (z.B. Tonhöhen oder Farbentönen) zu einem *Qualitätenkontinuum* beruht nicht auf einem besonderen Aufbauprinzip der *Ähnlichkeit* oder *qualitativen Verwandtschaft*, sondern die *Ähnlichkeit* der kontinuierlich verbundenen Qualitäten beruht auf einer von Qualität zu Qualität stattfindenden stetigen Gradsteigerung. Wir haben nämlich *zwei Arten der Gradsteigerung* zu unterscheiden: die Steigerung des *Qualitätsgrades* und die Steigerung des *Reinheitsgrades der Qualität*. Bei der Steigerung des Qualitätsgrades variiert nur *eine* Qualität (z.B. die Schwere), die dem Grade nach zu- oder abnimmt. Die Steigerung des Reinheitsgrades dagegen findet in einer Reihe von *Zwischenqualitäten* zwischen zwei *Grundqualitäten* (z.B. Schwarz und Weiss, Blau und Grün) statt oder auch in einer Reihe von *Zwischenqualitäten* zwischen zwei *Zwischenqualitäten* (z.B. zwischem einem Blaugrün und einem Grau). In jeder der beiden Richtungen der *Zwischenqualitätenreihe* (z.B. der Schwarzweissreihe) nimmt die Reinheit der einen der beiden Qualitäten

(z.B. die Weisslichkeit oder Schwärzlichkeit eines Grau) bis zu maximaler Reinheit auf Kosten der anderen zu. In einer Zwischenqualitätenreihe variieren also zwei Qualitäten, von denen die eine bis zum Maximum der Reinheit zunimmt, während die andere bis zum völligen Ausfall abnimmt.

Die Steigerung der sogenannten Intensität, des *Stärkegrades* einer Qualität, ist ein Unterfall der Steigerung des *Qualitätsgrades*. Der *Qualitätston* der Schwere, Härte, Süsse, Lautheit, Wärme usw. nimmt hierbei dem Grade nach zu bzw. ab. Ebenso ist aber auch die Steigerung des räumlichen Höhen-, Breiten- und Tiefengrades und die stetige oder sprunghafte Abnahme des zeitlichen Vergangenheitsgrades bei der diskreten Zeitfolge und der kontinuierlichen Dauer eine Steigerung nach *Qualitätsgraden*. Dasselbe gilt endlich auch für die stetige oder sprunghafte Zunahme bzw. Abnahme der von der Schwingungszahl abhängigen Qualität der „Tonhöhe“, die in der Musikersprache als „Steigen“ und „Fallen“ bezeichnet wird. Mit der Lagequalität der „räumlichen Höhe“ hat also die „Tonhöhe“ bei aller qualitativen Verschiedenheit die Steigerung nach *Qualitätsgraden* gemeinsam. Dagegen ist die stetige oder sprunghafte Variation der *Farbenqualitäten* eine *Gradssteigerung* nach *Reinheitsgraden*.

Dies gilt nicht nur für die „Helligkeit“ der Farbe, d.h. die Zunahme bzw. Abnahme ihrer Weisslichkeit oder Schwärzlichkeit, sondern auch für den Farbenton im engeren Sinne und für die Sättigung. Die Zwischenfarben zwischen Rot und Gelb, Gelb und Grün, Grün und Blau, Blau und Rot sind ebenso nach *Reinheitsgraden* (Graden der Rötlichkeit bzw. Gelblichkeit usw.) abgestuft wie die Grautöne der Schwarzweissreihe. In jeder bunten Zwischenqualitätenreihe findet phänomenologisch dieselbe Annäherung an eine der beiden Grundfarben statt, die in der Schwarzweissreihe aus genetischen Gründen ohne weiteres als positive bzw. negative Gradsteigerung der „Helligkeit“ anerkannt wird. Andererseits ist die Gradsteigerung der Weisslichkeit bzw. Schwärzlichkeit in der Schwarzweissreihe *phänomenologisch* ebenso eine Gradsteigerung nach *Reinheitsgraden* und nicht etwa nach *Stärkegraden* wie die Gradsteigerung der Rötlichkeit bzw. Gelblichkeit in der Rotgelbreihe und der Rötlichkeit bzw. Bläulichkeit in der Rotblaureihe. Endlich ist die Reihe der *Sättigungsgrade* einer bunten Farbe eine nach

Reinheitsgraden abgestufte Zwischenfarbenreihe zwischen der maximal gesättigten bunten Farbe, in der jeder Grauanteil fehlt, und einem reinen Grau, in dem der bunte Farbenton völlig ausgeschaltet ist.

Somit beruht der *ununterbrochene phänomenale Zusammenhang*, wie die angeführten Beispiele zeigen, bei allen vier Hauptarten der Kontinuen auf dem Aufbauprinzip der stetigen Gradsteigerung von Qualitäten mit ihren zwei Unterarten, der Gradsteigerung nach Qualitätsgraden und der Gradsteigerung nach Reinheitsgraden.

Carl Stumpf (Tonpsychologie 1. Bd., Leipzig 1883, S. 141, 147 ff.) gebraucht den von ihm zunächst nur für die Intensitäten verwendeten Begriff der Steigerung in „weitere Fassung“ auch für den „Fortschritt in bestimmter unvertauschbarer Richtung“ bei den Tönhöhen. Gelegentlich (S. 399) ist auch von der „Steigerung in der Richtung auf eine bestimmte Grundfarbe und das Maximum der Sättigung“ die Rede. Stumpf sieht aber in der „Steigerung“ keine zweite Grundklasse der sinnlichen Wahrnehmungsphänomene neben den Qualitäten, sondern rechnet sie zu den Verhältnissen (Beziehungen) die er mit einem scholastischen Ausdruck als *ens rationis cum fundamento in re* bezeichnet (a.a.O. S. 96 f.).

Hinsichtlich der Beziehung der „Tonhöhe“ zur „räumlichen Höhe“ vgl. G. Révész, Gibt es einen Hörraum? Acta Psychologica (Haag 1937) Bd. III S. 137 ff. Nach der Analyse von Révész hat das rein akustische Erlebnis der Tonhöhe mit der räumlichen Höhe nichts zu tun, sondern nur die vibratorische Komponente der Schalleindrücke, die in das Gebiet der *haptischen* Raumwahrnehmung gehört. Dies hindert nicht, dass Tonhöhe und räumliche Höhe die Steigerung nach Qualitätsgraden gemeinsam haben. Dagegen werden die stetigen Veränderungen der „*musikalischen Qualität*“ (G. Révész, Tonpsychologie Leipzig 1913), die durch die in jeder Oktav wiederkehrenden Tonnamen bezeichnet wird, anscheinend als eine Art Variation des „Reinheitsgrades“ erlebt, ebenso wie die stetigen Veränderungen der *Vokale* (z.B. von a über ae nach e), gleichviel wie die Entstehung und die musikalische bzw. sprachliche Auszeichnung der als rein erlebten Qualitäten in diesen beiden Fällen zu erklären sein mag. Auffallend ist übrigens die Uebereinstimmung der Fünzfzahl der Vokale und der ältesten fünfstufigen Tonleitern, die nur Ganztöne enthalten.

Das phänomenale Aufbauprinzip der stetigen Gradsteigerung begründet nicht nur die spezifische Ganzeigenschaft der Kontinuen, den ununterbrochenen Zusammenhang, sondern modifiziert dadurch gleichzeitig die den Kontinuen mit den phänomenalen Reihen gemeinsamen Ganzeigenschaften der Grösse und Ordnung. Vermindern wir in einer diskreten Reihe (z.B. von Gradabstufungen der Tonhöhe oder Lautheit, von ab-

nehmenden Vergangenheitsgraden oder räumlichen Höhengraden) allmählich die Grösse der phänomenalen Sprünge, so geht die sprunghafte Gradsteigerung schliesslich in die stetige über, ehe jede Steigerung ausfällt. Gleichzeitig aber geht die *gegliederte Ordnung* der diskreten Reihe in die *ungegliederte Ordnung* der Kontinuen über, und damit geht auch die *diskrete Grösse* der Anzahl der Glieder über in die *kontinuierliche Grösse der Ausdehnung* im weitesten Sinne des Wortens, die ausser der räumlichen Ausdehnung die zeitliche Ausdehnung oder Dauer und die variable stetige Grösse eines Intensitäts- oder Qualitätenkontinuums, etwa eines Kontinuums von Tonhöhen, mitumfasst.

Der ununterbrochene phänomenale Zusammenhang von Qualitäten, den das Aufbauprinzip der stetigen Gradsteigerung schafft, begründet also zugleich die *ungegliederte Verbundenheit* dieser Qualitäten untereinander, während die sprunghafte Gradsteigerung eine gegliederte Verbundenheit der Qualitäten konstituiert. Wie die stetige Gradsteigerung das phänomenale Aufbauprinzip des Zusammenhangs von Qualitäten eines Gebietes ist, so ist die *sprunghafte Gradsteigerung* das *phänomenale Aufbauprinzip ihrer gegliederten Verbundenheit* untereinander, d.h. der Zusammenhang des durch stetige Gradsteigerung aufgebauten *Kontinuums* ist das phänomenale Gegenstück zu der gegliederten Verbundenheit des durch sprunghafte Gradsteigerung aufgebauten *Diskretums*. Zusammenhang und Gliederung schliessen sich demnach *auf demselben Gebiet* aus. Dies hindert nicht, dass der zeitlich oder räumlich ununterbrochene Zusammenhang mit einer Gliederung der Sinnesqualitäten im engeren Sinne einhergehen kann. Ebenso bleibt beispielsweise in einem rechten Winkel mit einem vertikalen und einem horizontalen Schenkel bei dem sprunghaften Übergang der stetigen räumlichen Höhensteigerung in die stetige räumliche Breitensteigerung doch die das räumliche Kontinuum kennzeichnende stetige Gradvariation der Ortsqualität erhalten. Denn es geht nur die stetige Gradvariation ihrer Höhenkomponente sprunghaft in eine ebenfalls stetige Gradvariation ihrer Breitenkomponente über. Die dadurch entstehende *Diskontinuität hinsichtlich der Richtung* des linearen Kontinuums ist mit der Kontinuität seiner Ausdehnung wohl verträglich, ebenso wie Kontinuität der Ausdehnung mit Diskontinuität der Farbe zusammenbestehen kann.

Die enge Beziehung zwischen der phänomenalen Grösse der *Anzahl* des Diskretums und der phänomenalen Grösse der *Ausdehnung* des Kontinuums erhellt aus dem stetigen Übergang der beiden Ganzeigenschaften ineinander. Bei abnehmender Grösse der sprunghaften Gradsteigerung geht sowohl bei räumlichen und zeitlichen Reihen wie bei Intensitätsreihen und Qualitätenreihen die diskrete Wiederholung von Gradabstufungen der gleichen Qualität in ihre kontinuierliche Wiederholung und dadurch Anzahl in Ausdehnung im weitesten Sinne über. Das Grössenphänomen der Anzahl der Glieder einer Reihe und das Grössenphänomen der Ausdehnung eines Kontinuums unterscheiden sich demnach nur darin, dass das Aufbauprinzip der Anzahl die bei den Reihen mit sprunghafter Gradsteigerung verbundenen *diskrete* Wiederholung, das Aufbauprinzip der Ausdehnung die mit stetiger Gradsteigerung verbundene *kontinuierliche* Wiederholung ist. Alle auf dem Aufbauprinzip der Wiederholung beruhenden Eigentümlichkeiten der Ganzeigenschaft der Grösse, insbesondere die strukturgesetzlich unbegrenzte Fortsetzbarkeit und die Teilbarkeit sind daher der Anzahl und der Ausdehnung gemeinsam ⁸⁾. Sie unterscheiden sich nur in den durch die *kontinuierliche* Wiederholung begründeten besonderen Eigentümlichkeiten, nämlich durch den ununterbrochenen und beim Fehlen *jeder* Diskontinuität auch ungegliederten Zusammenhang der Ausdehnung, der die an die diskrete Wiederholung gebundene phänomenale Zählbarkeit und zwar sowohl hinsichtlich der Kardinalzahlen wie der Ordnungszahlen aufhebt. Dagegen bleiben die Stellenphänomene des Anfangs, des Endes und des Zwischen auch bei der kontinuierlichen Grösse der Ausdehnung erhalten. Denn bei jeder Ausdehnung im weiteren Sinn, z.B. auch in einem Tonhöhenkontinuum, erleben wir eine Qualität (Tonhöhe, räumliche, zeitliche Lagequalität), die hinsichtlich der stetigen Gradsteigerung keinen Vorgänger hat (Anfang), eine Qualität, die hinsichtlich der stetigen Gradsteigerung keinen Nachfolger hat (Ende) und eine phänomenal ungeschiedene Mannigfaltigkeit von Zwischenstufen in der stetigen Gradsteigerung (z.B. von Tonhöhen, räumlichen Höhengraden, Vergangenheitsgraden), die dem Anfang nachfolgen und dem Ende vorangehen.

⁸⁾ Vgl. Beitrag 2.

§ 5. *Das Bildungsgesetz des Vollkontinuums und der Vollreihe.*

Wir verstanden bisher unter einem phänomenalen Kontinuum eine stetige Qualitätenreihe, sei es von gradabgestuften Sinnesqualitäten im engeren Sinne (Tonhöhen, Farbentönen) oder von Stärkegraden einer Qualität, sei es von zeitlichen oder räumlichen Lagequalitäten (Vergangenheitsgraden, Höhen-Breiten-Tiefengraden). Von einem Kontinuum in diesem engeren Sinne ist das qualitätserfüllte zeitliche oder räumliche *Vollkontinuum* der sinnlichen Anschauung wohl zu unterscheiden, das im weiteren Sinne ebenfalls als Kontinuum bezeichnet werden kann. Ein ununterbrochen dauernder Ton, eine gleichförmig (homogen) gefärbte Kreisfläche sind Beispiele eines Vollkontinuums.

Das *Vollkontinuum* und die ihm entsprechende anschauliche *diskrete Vollreihe* sind zunächst allgemein durch eine doppelte Ordnung ausgezeichnet, erstens durch die *eigengesetzliche Ordnung* der zeitlichen bzw. räumlichen Lagequalitäten, zweitens durch die *fremdgesetzliche Ordnung* oder *Anordnung* der Sinnesqualitäten (Töne, Farben) vermöge der ihnen zukommenden zeitlichen bzw. räumlichen Lagequalitäten. Gehören die durch zeitliche bzw. räumliche Anordnung verbundenen Sinnesqualitäten ein und derselben Ähnlichkeitsreihe an (z.B. Tonhöhen, Graustufen, Rotgelbstufen), so sind sie ausserdem *in der Reihenfolge ihrer Anordnung* auch noch *eigengesetzlich*, d.h. ihrer Beschaffenheit nach, durch Gradsteigerungsphänomene verbunden. Hierbei kann wieder eine Ordnung nach dem Reihenprinzip oder auch eine Ordnung nach einem anderen Bildungsgesetz, z.B. dem einer Melodie, sich aufbauen. Da die jeweilige eigengesetzliche phänomenale Ordnung der Sinnesqualitäten jedoch zwangsläufig von ihrer zeitlichen bzw. räumlichen Anordnung, ihrer unmittelbaren zeitlichen bzw. räumlichen Folge abhängt (*Gesetz der unmittelbaren Folge*), so ist die auf dem Reihenprinzip beruhende Ordnung die *primäre Grundlage* jeder phänomenalen Ordnung. Auch das Bildungsgesetz einer nicht dem Reihenprinzip folgenden qualitativen Ordnung ist ein Gesetz der zeitlichen bzw. räumlichen *Folge* der Qualitäten. Insofern ist jede Ordnung Reihenordnung, nämlich Ordnung einer Vollreihe. Nach dem beschriebenen Bildungsgesetz der Vollreihen kann aber ihre zeitliche bzw. räumliche Ordnung

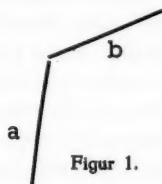
sowohl mit einer Anordnung der Sinnesqualitäten nach einem Reihenprinzip wie mit einer Anordnung nach einem anderen Bildungsgesetz verbunden sein.

Ausser durch Gradsteigerungsphänomene können die unmittelbar aufeinanderfolgenden Sinnesqualitäten eines Vollkontinuums oder einer diskreten Vollreihe auch durch Wiederholungsphänomene in sich verbunden oder endlich (wie z.B. die unähnlichen Farben einer Flagge) in sich unverbunden sein. Nicht nur die stetige Gradsteigerung der Sinnesqualität (z.B. der Tonhöhe oder Lautheit), sondern vor allem auch die durch kontinuierliche Wiederholung entstehende „Gleichförmigkeit“ oder „Konstanz“ der Sinnesqualität (z.B. eines ununterbrochenen dauernden Tones oder einer homogen gefärbten Fläche) baut ein *ungegliedertes Vollkontinuum* auf. Dagegen entsteht eine *gegliederte Verbundenheit* der sich kontinuierlich aneinanderfügenden Teile des Vollkontinuums erstens durch sprunghafte Gradsteigerung der Sinnesqualität (z.B. durch sprunghafte Zunahme bzw. Abnahme der Tonhöhe oder Lautheit der zeitlich kontinuierlich verbundenen Töne). Zweitens konstituiert auch völlige Verschiedenheit, also Heterogenität, der kontinuierlich aufeinanderfolgenden Sinnesqualitäten des Vollkontinuums eine *gegliederte Verbundenheit*, da die heterogenen Sinnesqualitäten zwar in sich (untereinander) unverbunden, durch ihre räumliche bzw. zeitliche Anordnung aber, wie beispielsweise im Falle der Flagge, zu einer *spezifischen Anordnungsgestalt* verbunden sind. Dieselben Farben ergeben hierbei in verschiedener räumlicher Folge eine verschiedene Flagge. Die „Anordnungsgestalt“ ist also durch die spezifische Anordnung der in ihr verbundenen Qualitäten oder Ganzen aus solchen sowohl von dem Fall einer völligen Unverbundenheit der Qualitäten als auch von einem phänomenalen *Aggregat* (einer Summe oder Menge), deren Glieder beliebig vertauschbar sind, wohl unterschieden.

Ein Kontinuum ist gegliedert, wenn seine Ausdehnung phänomenale Teile enthält. Nach dem allgemeinen Bildungsgesetz der phänomenalen Kontinuen (§ 4) müssen auch die entstehenden Teilkontinuen durch die Stellenphänomene „Anfang“ bzw. „Ende“ also durch *Grenzen*, gekennzeichnet sein. Weder die Konstanz der Sinnesqualitäten noch ihre stetige Gradsteigerung lässt Grenzen innerhalb des Kontinuums entstehen. Daher

begründen die Konstanzphänomene und stetigen Gradsteigerungsphänomene der Sinnesqualität den phänomenal ungegliederten Zusammenhang des Vollkontinuums. Hiergegen entstehen sowohl durch sprunghafte Gradsteigerung der Qualität wie durch die zeitliche bzw. räumliche Aufeinanderfolge heterogener Sinnesqualitäten Stellen *innerhalb* des Kontinuums, wo eine Qualität phänomenal anfängt bzw. wieder aufhört, also Grenzen im Inneren des Kontinuums, die seine *Gliederung in Teile begründet*.

Das phänomenale *zeitliche Kontinuum* im engeren Sinne mit seiner stetigen Abnahme des Vergangenheitsgrades enthält kein Prinzip der Gliederung. Alle Gliederung des zeitlichen Vollkontinuums, z.B. seine rhythmische oder Taktgliederung, beruht daher auf diskontinuierlichen Veränderungen der erfüllenden Qualität, durch die sich phänomenale Teile, z.B. einzelne Töne, innerhalb der kontinuierlichen Zeiterfüllung abgrenzen. Dagegen enthält das phänomenale *räumliche Kontinuum* in der sprunghaften Veränderung des Komponentenanteils der räumlichen Gradsteigerung (z.B. des phänomenalen Anteils von Höhen- und Breitensteigerung) und damit der Richtung ein *immanentes Prinzip der Gliederung*, auf dem die gebrochene Linie beruht. So entsteht die gebrochene Linie der Figur 1 dadurch, dass beim Übergang von Abschnitt *a* zu Abschnitt *b* eine Zunahme des phänomenalen Anteils der Breitensteigerung auf Kosten der Höhensteigerung und damit eine sprunghafte Variation der phänomenalen Richtung stattfindet.



Figur 1.

Während also bei Konstanz der Sinnesqualität keine Gliederung des zeitlichen Kontinuums möglich ist, gibt es räumliche Kontinuen, deren Gliederung nicht auf dem Prinzip einer diskontinuierlichen Variation der erfüllenden Sinnesqualität beruht, sondern die durch sprunghafte Richtungsvariation *in sich selbst* gegliedert sind. Das räumliche Vollkontinuum kann

daher im Gegensatz zum zeitlichen auch bei Konstanz der Sinnesqualität (Farbe) gegliedert sein. Der Grund für diesen Unterschied liegt in der *Mehrdimensionalität* der räumlichen Gradsteigerungsphänomene. Sie macht unbeschadet der die Ausdehnung aufbauenden stetigen Gradvariation der Ortsqualität eine sprunghafte Variation des Komponentenanteils der Steigerung, z.B. des Anteils der Höhen- und Breitensteigerung, möglich. *Die Kontinuität der Ausdehnung* kann infolgedessen mit einer gliedernden Diskontinuität der Richtung verbunden sein.

Lassen wir eine diskrete *Vollreihe* aus gleichen Qualitäten (aus Tönen von gleicher Höhe und Stärke, aus schwarzen Punkten) durch Verringerung der zeitlichen bzw. räumlichen Abstände allmählich in ein *Vollkontinuum* übergehen, so erleben wir, wie beim Übergang der sprunghaften zeitlichen bzw. räumlichen Gradsteigerung in die stetige Gradsteigerung Gliederung in ununterbrochene Zusammenhang und damit einerseits *Gleichheit* der Sinnesqualität in Gleichförmigkeit oder *Konstanz* und andererseits *Anzahl in Ausdehnung* übergeht. Der Übergang von Anzahl in Ausdehnung im Bereich der Orts- und Zeitqualitäten hat also in dem Übergang von Gleichheit in Gleichförmigkeit oder Konstanz im Bereich der räumlich oder zeitlich angeordneten Sinnesqualitäten seine genaue Parallele. Wie die *stetige Gradsteigerung* die ununterbrochene Ausdehnung an Stelle der diskreten Anzahl treten lässt, so schafft die mit ihr verbundene *kontinuierliche Wiederholung* Gleichförmigkeits- oder „Konstanzphänomene“ an Stelle der diskreten „Gleichheitsphänomene“. Die Konstanz einer oder mehrerer Komponenten der Ortsqualität ist hierfür ein weiteres Beispiel. So ist in einer frontalparallelen Ebene die stetige Gradvariation der Höhen- und Breitenqualität mit einem Konstanzphänomen hinsichtlich der Tiefenqualität verbunden. Ebenso ist in einer Vertikalen die stetige Gradsteigerung der Höhenqualität mit einem Konstanzphänomen sowohl hinsichtlich der Breiten- wie der Tiefenqualität verbunden.

Wie das „Konstanzphänomen“ nur der *Grenzfall* der kontinuierlich gewordenen Wiederholung derselben Qualität ist, so ist das Phänomen der „Ausdehnung“ nur der Grenzfall der kontinuierlich gewordenen Gradsteigerung. Dies gilt für die räumliche und zeitliche Gradsteigerung nicht minder wie für

die Gradsteigerung von Intensität und Qualität. Die mit der stetigen Gradsteigerung verbundene kontinuierliche Wiederholung von Gradabstufungen konstituiert hierbei die kontinuierliche Grösse der Ausdehnung ebenso wie die mit der sprunghaften Gradsteigerung verbundene Wiederholung von Gradabstufungen in einer diskreten Reihe die Grösse der Anzahl ihrer Glieder aufbaut.

§ 6. *Die angebliche Unzurückführbarkeit der Ausdehnung.*

Gegen die Analyse der Ausdehnung eines zeitlichen oder räumlichen Kontinuums als stetiges Gradsteigerungsphänomen könnte gleichwohl noch der Einwand versucht werden, dass die durch den Wegfall der zeitlichen bzw. räumlichen Abstände kontinuierlich verbundenen *Sinnesqualitäten des Vollkontinuums keinen unausgedehnten Ort einnehmen*, sondern immer schon eine minimale zeitliche bzw. räumliche Ausdehnung besitzen. Dieser Einwand versagt jedoch bei den Qualitätenkontinuen (z.B. den Tonhöhenkontinuen) und den Intensitätskontinuen. Sie lehren, dass mit dem Übergang der sprunghaften Gradsteigerung in die stetige auch dort ein Kontinuum von bestimmter variierender „Ausdehnung“ entsteht, wo vorher nur ausdehnungslose Gradabstufungen (hier der „Qualität“ bzw. „Intensität“) vorhanden waren.

Mit dem Hinweis auf die Entstehung von Kontinuen durch stetige Gradsteigerung von Qualitäten schwindet die scheinbar zwingende Logik des von Carl Stumpf in seinen Untersuchungen „Über den Ursprung der Raumvorstellung“ (1873) vorgebrachten Arguments, dass ein komplexes Phänomen der Ausdehnung sich nur aus elementaren Ausdehnungen und nicht aus ausdehnungslosen Orten aufbauen könne. Der einzelne vorgestellte Ort müsse, so meint Stumpf, „notwendig bereits eine bestimmte Ausdehnung“ besitzen. „Denn aus lauter Nullen von Ausdehnung wird sich nie eine endliche Ausdehnung zusammensetzen lassen“⁹⁾. Es ist jedoch ebensowenig widerspruchsvoll, sich ein Ortskontinuum aus dem Grade nach stetig abgestuften Ortsqualitäten (Höhen-, Breiten-, Tiefenqualitäten) und ein Zeit-

⁹⁾ Auch für den Nativismus von E. Hering sind Ausdehnung und Ort gleich ursprüngliche Eigentümlichkeiten der Gesichtsempfindungen. Vgl. z.B. Der Raumsinn und die Bewegungen des Auges, Handbuch der Physiologie, herausg. von L. Hermann, Bd. III, Teil 1 S. 345.

kontinuum aus stetig abgestuften abnehmenden Vergangenheitsgraden aufgebaut zu denken wie ein Intensitätskontinuum aus stetig gradabgestuften Intensitäten und ein Tonhöhenkontinuum aus stetig gradabgestuften Tonhöhen. Vielmehr ist die stetige Abnahme des Vergangenheitsgrades im Phänomen der Dauer oder beispielsweise die stetige Zunahme des räumlichen Höhengrades in einer Vertikalen ebenso als Aufbauprinzip des zeitlichen bzw. räumlichen Kontinuums erlebbar wie die stetige Zunahme bzw. Abnahme der Tonhöhe oder Tonstärke als Aufbauprinzipien der entsprechenden Kontinuen von Sinnesqualitäten.

Wer die Analyse der räumlichen Ausdehnung dadurch entbehrlich zu machen meint, dass er die flächenhafte Ausdehnung für ein Attribut der elementaren *Empfindung* (insbesondere der Gesichts- und Tastempfindung) neben Qualität und Intensität erklärt, hat das Problem damit nur zurückgeschoben. Denn es entsteht als bald von neuem bei der Frage, nach welchem Prinzip nun die qualitätserfüllten „elementaren Ausdehnungen“, die nach Annahme alle einander gleich sind, sich zu der komplexen mehrdimensionalen Ausdehnung und Gestalt eines räumlichen Kontinuums aneinanderfügen. Wird die räumliche Ausdehnung dagegen auf die stetige Gradsteigerung der räumlichen Lagequalität zurückgeführt, so ist es möglich *aus demselben Aufbauprinzip* auch die zusammenhängende Verbindung *mehrerer*, durch eine Diskontinuität der Sinnesqualität oder der Richtung phänomenal geschiedenen Ausdehnungen zu erklären. Der kontinuierliche Fortgang der stetigen räumlichen Gradsteigerung bei der sprunghaften Variation der Farbe oder der Richtung stellt die räumliche Verbindung zu einer Gesamtausdehnung trotz der Gliederung her. Die *Art* der stetigen Gradsteigerung der Ortsqualität aber, die im linearen Kontinuum entweder mit Konstanz des Komponentenanteils (z.B. des Anteils der Höhen- und Breitensteigerung) und damit der Richtung oder mit der stetigen bzw. sprunghaften Variation des Komponentenanteils und damit der Richtung verbunden sein kann, entscheidet zugleich über die Gestalt des durch die stetige Gradsteigerung aufgebauten Kontinuums.

Der *Grenzfall* der *Punktgestalt* des *minimum visible*, die sogenannte „elementare Ausdehnung“, ist nur ein Rudiment der ein kreisartiges flächenhaftes Teilkontinuum aufbauenden zwei-

dimensionalen stetigen räumlichen Gradsteigerung. Die Punktgestalt entsteht nämlich dadurch, dass ein minimales Gebiet innerhalb eines flächenhaften Gesamtkontinuums von einer anderen Sinnesqualität erfüllt ist. Wie jede „Figur“ liegt dabei auch das figürliche Minimum des Punktes *vor* dem flächenhaften „Grund“, d.h. er ist nicht nur durch die besondere Farbe, sondern auch noch durch einen Unterschied in der Tiefenkomponente ausgezeichnet¹⁰⁾.

Hatte die von C. Stumpf am schärfsten durchgedachte nativistische Lehre darin Unrecht, dass sie das Phänomen einer flächenhaften Ausdehnung für *schlechthin* unzurückführbar hielt, so bemühte sich der „Empirismus“ vergeblich, die räumliche Ausdehnung unter Vermeidung der Anerkennung eines spezifischen Raumsinnes auf eine Art chemischer Synthese von Sinnesqualitäten *anderer* Sinne zurückzuführen. Der Raum- und Zeitsinn hat jedoch seine eigenen unzurückführbaren und wie auf anderen Sinnesgebieten gradabgestuften Qualitäten, die Orts- und zeitlichen Lagequalitäten mit ihren Qualitätsstönen und Qualitätsgraden. Die stetige Gradsteigerung dieser spezifischen Qualitäten des Raum- und Zeitsinnes aber baut das räumliche und zeitliche Kontinuum ebenso auf wie die stetige Gradsteigerung der Intensität und der Qualität im engeren Sinne ein Intensitäts- oder Qualitätenkontinuum. Die Anerkennung der gradabgestuften Orts- und zeitlichen Lagequalitäten als der *unzurückführbaren Grundphänomene des Raumsinnes und des Zeitsinnes* bildet also den Schlüssel zur Analyse des phänomenalen Kontinuums. Wie die 6 Grundfarben (Rot, Gelb, Grün, Blau, Weiss, Schwarz), so sind auch die 6 Grundortstöne des Oben und Unten, des Rechts und Links, des Vorn und Hinten und die zwei zeitlichen Grundqualitäten des Vergangenen und Zukünftigen letzte phänomenale Gegebenheiten ihres Sinnesgebiets. Ihre stetigen Gradabstufungen aber einschliesslich der nach Reinheitsgraden abgestuften *Zwischenortstöne* (wie Vorne-rechts, Vornelinks, Vorneoben und Vorneunten) ermöglichen eine stetige Gradsteigerung, sei es nach Qualitätsgraden, sei es nach Reinheitsgraden, die das phänomenale Aufbauprinzip der zeitlichen- bzw. räumlichen Kontinuen bildet.

¹⁰⁾ Vgl. Ueber das Figur-Grundproblem auch O. Selz, Gestalten und Steigerungsphänomene, Archiv f. d. ges. Psychologie, 91, II § 5—9.

Die *synthetische Raum- und Zeittheorie*, die wir sowohl dem Nativismus wie dem Empirismus gegenüberstellen, unterscheidet sich demnach vom Nativismus durch die Bestreitung der Unzurückführbarkeit von Ausdehnung und Dauer, vom Empirismus aber nicht nur durch die Anerkennung der Orts- und zeitlichen Lagequalitäten als spezifischer Qualitäten des Raum- und Zeitsinnes, sondern auch durch den Nachweis der phänomenalen Verbindungsweise der stetigen Gradsteigerung als des *allgemeinen* Aufbauprinzips, das die Synthese der Qualitäten ein- und desselben Sinnesgebietes zum phänomenalen Kontinuum möglich und zugleich begreiflich macht. Die *Anerkennung spezifischer Qualitäten des Raum- und Zeitsinnes als seiner Grundphänomene* ist sohin nur die eine der beiden Besonderheiten der synthetischen Raum- und Zeittheorie. Sie erfährt ihre notwendige Ergänzung in dem Nachweis der *spezifischen* Natur der *phänomenalen Synthese*, die sehr im Gegensatz zu aller chemischen Synthese auf *phänomenal aufweisbaren* und daher in ihrem „Wesen“ erkennbaren Prinzipien beruht wie dem der stetigen Gradsteigerung. Die in ihrem Wesen erkennbare Verbindung aber macht den Aufbau und damit die Eigenschaften der phänomenalen Ganzen unmittelbar *einsichtig* und erfüllt damit die höchsten Ansprüche an „Einsicht“ oder rationale Begreiflichkeit, der gegenüber selbst die rationale Begreiflichkeit des lediglich durch Schlüsse gefolgerten als eine bloss abgeleitete, von den Voraussetzungen abhängige Einsicht sich darstellt.

§ 7. *Der Übergang durch unmerklich verschiedene Zwischenstufen und das phänomenale Kontinuum.*

Als das gemeinsame Merkmal der phänomenalen Kontinuen, der räumlichen und zeitlichen, der Intensitäts- und Qualitätenkontinuen, betrachtete die Psychologie bisher keineswegs die stetige Gradsteigerung. Ohne die Unterscheidung von Qualitätsgraden und Reinheitsgraden der Qualität und ohne die Anerkennung der gradabgestuften Ortsqualitäten und zeitlichen Lagequalitäten als der *primären Phänomene* des Raum- und Zeitsinnes fehlten hierfür die theoretischen Voraussetzungen. Der Nachweis der stetigen Gradsteigerung als Aufbauprinzip *aller* phänomenalen Kontinuen ist nur auf dem Boden einer soeben gekennzeichneten Raum- und Zeittheorie durchführbar,

deren Leistungsfähigkeit gerade bei der Analyse des phänomenalen Kontinuums und der ihm eigene Gestaltetheit zutage tritt. Der Nachweis der stetigen Gradsteigerung als allgemeines Aufbauprinzip der phänomenalen Kontinuen entscheidet also zugleich zu Gunsten einer Raum- und Zeittheorie, die Ausdehnung und Dauer nicht mehr als primäre Phänomene des Raum- und Zeitsinnes betrachtet, sondern aus der stetigen Variation der Orts- und zeitlichen Lagephänomene herleitet.

Allein die hergebrachte Auffassung des phänomenalen Kontinuums sieht nicht die stetige Gradsteigerung, sondern den Übergang durch unmerklich verschiedene Zwischenstufen als allgemeines Kennzeichen eines phänomenalen Kontinuums an. So begründet Ebbinghaus die Kontinuierlichkeit der dreidimensionalen Ordnung des Systems der Farben wie folgt: „Die gesamte Fülle aller Farben bildet eine *kontinuierliche Mannigfaltigkeit*. D. H. (!) man kann von jeder beliebigen Farbe auf zahlreiche Weisen durch Zwischenglieder, von denen zwei benachbarte gar nicht mehr voneinander unterschieden werden können, zu jeder anderen Farbe übergehen“¹¹⁾. Diese Beschreibung passt zwar auf eine Anordnung der Farben, die der kontinuierlichen Variation der Reize entspricht, aber nicht auf die Ordnung der Farben, die den Eindruck eines *phänomenalen* Kontinuums hervorruft. Dieser entsteht vielmehr erst, wenn aus der Reihe alle ununterscheidbaren Stufen als störend ausgeschieden werden, so dass nur mehr *ebenmerklich verschiedene* Zwischenstufen, z.B. von Grautönen zwischen Schwarz und Weiss, einander folgen¹²⁾. Die „ebenmerklichen“ Zwischenstufen aber sind identisch mit dem Fall der stetigen Gradsteigerung, in unserem Beispiel also mit der stetigen Steigerung des Helligkeitsgrades.

Der Übergang durch unmerklich verschiedene Zwischenstufen ist also durchaus nicht das Aufbauprinzip des phänomenalen Kontinuums. Er ist vielmehr gerade umgekehrt die *Bedingung der Aufhebung des Phänomens einer kontinuierlichen Variation trotz der kontinuierlichen Variation der Reize*. So erhält sich

¹¹⁾ H. Ebbinghaus, Grundzüge der Psychologie, 4. Aufl., bearbeitet von Karl Bühler, (Leipzig 1919) S. 202.

¹²⁾ Ebbinghaus' eigene Beschreibung der Schwarzweissreihe (a.a.O. S. 198) entspricht dieser Forderung und nicht seiner Definition der kontinuierlichen Mannigfaltigkeit.

das Phänomen der kontinuierlichen Ortsveränderung oder der Bewegung bei Verringerung ihrer phänomenalen Geschwindigkeit nur solange, als sich mit der Zunahme der Dauer der Bewegung eine „merkliche“ oder, was dasselbe heisst, eine „phänomenale“ Zunahme ihrer Ausdehnung verbindet. Sobald sich dagegen mit der zeitlichen Gradsteigerung infolge zu geringen Anteils der räumlichen Komponente der Steigerung keine „merkliche“ Gradvariation der Ortsqualität mehr verbindet, tritt an Stelle eines Phänomens der stetigen Ortsvariation in der Dauer oder der Bewegung ein Konstanzphänomen, das Phänomen der Ortskonstanz in der Dauer oder der Ruhe, obwohl objektiv noch eine Bewegung vorliegt. Wir sehen dann keine kontinuierliche Ortsveränderung mehr, sondern bemerken nur noch von Zeit zu Zeit, z.B. beim Minutenzeiger unserer Uhr, dass der scheinbar (phänomenal) konstante Ort des Objekts eine nicht wahrgenommene Veränderung erlitten hat. Der Eintritt des Übergangs durch unmerklich verschiedene Zwischenstufen bei Verlangsamung der objektiven Bewegung bringt also das Phänomen der kontinuierlichen Ortsveränderung, das die stetige Gradsteigerung der Ortsqualität zur Voraussetzung hat, zur Aufhebung und setzt an seine Stelle das auf der kontinuierlichen Wiederholung derselben Ortsqualität in der Dauer beruhende Phänomen der Ortskonstanz oder der Ruhe. Die „unmerkliche Verschiedenheit der Zwischenstufen“ ist eine nicht erlebte, sondern (mit Recht oder Unrecht) erschlossene Verschiedenheit der Phänomene, die unter der sogenannten *Unterschiedsschwelle*, nämlich der *Schwelle für Gradsteigerungsphänomene*, bleibt und daher in unserem Beispiel das Phänomen der Ortskonstanz und damit das Aufhören der phänomenalen Bewegung nicht verhindern kann. Wenn aber der Übergang durch unmerklich verschiedene Zwischenstufen das Phänomen der kontinuierlichen Variation aufhebt, ist es widersinnig, in dieser Art des Übergangs die Besonderheit des phänomenalen Kontinuums erblicken zu wollen.

§ 8. Das Aufbauprinzip der stetigen Gradsteigerung.

Wir verstehen unter einem *phänomenalen System* eine Reihe, die sämtliche Qualitäten eines Gebietes geordnet enthält. Die Reihe der Schweregrade, die Reihe der Lautheitsgrade, die Reihe der Tonhöhen, die Schwarzweissreihe, die aus der Rot-

gelb-, Gelbgrün-, Grünblau- und Blaurotreihe zusammengesetzte, in sich zurückkehrende „zyklische Reihe“ der bunten Farben sind also phänomenale Systeme im eben definierten Sinn. So fehlt in der Ordnung der Schwarzweissreihe keine neutrale, in der Ordnung des „Farbenzirkels“ keine bunte Farbe. Der Begriff des phänomenalen Systems ermöglicht uns nun eine präzise Begriffsbestimmung der phänomenalen Verbindungsweise der stetigen Gradsteigerung, ohne auf die ihr zugrundeliegenden Reize zurückgreifen zu müssen. Die stetige Gradsteigerung ist diejenige Form der Gradsteigerung, durch welche die in der Ordnung eines phänomenalen Systems unmittelbar aufeinanderfolgenden Qualitäten miteinander verbunden sind. Die aufeinanderfolgenden Qualitäten eines Qualitätensystems sind in der Sprache der Psychophysik durch einen „ebenmerklichen Unterschied“ gekennzeichnet. Dieser ebenmerkliche Unterschied aber beruht auf dem Phänomen der stetigen Gradsteigerung des Qualitätsgrades oder des Reinheitsgrades. In dem den Qualitätensystemen eigentümlichen gemeinsamen Aufbauprinzip der stetigen Gradsteigerung bestätigt sich der *einheitliche Aufbau der phänomenalen Welt*, der hierin der physischen Welt und insbesondere den Organismen nicht nachsteht. Infolge des Aufbauprinzips der stetigen Gradsteigerung sind alle auf der Herstellung von Ähnlichkeitsreihen beruhenden Qualitätensysteme phänomenale Kontinuen, sei es räumliche oder zeitliche, sei es Intensitäts- oder Qualitätenkontinuen.

Die zweite Form der Gradsteigerung, die sprunghafte Gradsteigerung, setzt die stetige des Qualitätensystems voraus. Sie ist ein *Ausfallsphänomen*, d.h. sie entsteht nur bei einer zeitlichen oder räumlichen Folge von Qualitäten, die in phänomenalen System nicht unmittelbar aufeinanderfolgen. Die sprunghafte Gradsteigerung variiert nach der phänomenalen Grösse der Sprünge (Intensitätssprünge, Intervalle, Distanzen). Diese hängt entweder von der Differenz der Reize ab wie bei den zeitlichen oder räumlichen Distanzphänomenen oder von dem Reizverhältnis wie bei den Intensitätssprüngen und Tonhöhen-sprüngen.

Verändert sich aus pathologischen Gründen das Qualitätensystem, so können Reize ein Kontinuumphänomen bedingen, die sonst sprunghafte Gradsteigerungsphänomene herbeiführen. So wurde in einem von *Grant Allen* beschriebenen Falle von sog-

nannter Tontaubheit die Tonleiter als Kontinuum erlebt, da infolge abnorm herabgesetzter Unterschiedsempfindlichkeit in ihr keine Tonhöehensprünge und infolgedessen keine Intervallphänomene auftraten. Der Patient konnte nirgends eine Abgrenzung zwischen einem Ton und seinem Nachbar bemerken; vielmehr erlebte er, wenn man die einzelnen Töne, welche durch die Klaviertasten angegeben wurden, der Reihe nach von unten bis oben spielte, ein kontinuierliches Ganzes¹³⁾.

Es gibt nur *eine einzige Art der stetigen Variation* und daher nur ein einziges Aufbauprinzip des kontinuierlichen Zusammenhanges, die stetige Gradsteigerung. Die Kontinuität der kontinuierlichen Wiederholungsphänomene oder „Konstanzphänomene“ ist eine mittelbare. Sie fusst auf den stetigen zeitlichen bzw. räumlichen Gradsteigerungsphänomenen, die den kontinuierlichen Zusammenhang der gleichen Qualitäten begründen. Dies gilt sowohl für die auf der zeitlichen bzw. räumlichen Anordnung beruhende Konstanz der Sinnesqualität wie für die Konstanz einer oder zweier Komponenten der Ortsqualität, die die stetige Gradsteigerung einer anderen Komponente voraussetzt. Ebenso geht die stetige Grössensteigerung beim Wachsen der Ausdehnung oder Dauer auf die stetige räumliche bzw. zeitliche Gradsteigerung zurück.

Die Steigerung der diskreten Grösse der Anzahl kann zwar gleichfalls sowohl *lückenlos* entsprechend der unmittelbaren Folge im System der Anzahlen als auch *sprunghaft* erfolgen. Die lückenlose Steigerung der Anzahl ist aber keine stetige Steigerung. Es besteht nämlich ein *strukturgesetzlicher Unterschied* zwischen der lückenlosen Steigerung der Anzahl nach dem Aufbauprinzip der Wiederholung (§ 1) und der stetigen Gradsteigerung. Zwischen zwei im System einander unmittelbar folgenden Anzahlen kann es strukturgesetzlich keine weiteren Anzahlen geben; denn das nach dem Aufbauprinzip der Wiederholung, dem Prinzip $+ 1$, empirisch aufgebaute System der Anzahlen enthält schon alle strukturgesetzlich möglichen Variationen der Wiederholungsphänomene hinsichtlich ihrer Zusammengesetztheit bis zu einer bestimmten Anzahl. Dagegen lassen sich in einem nach dem Prinzip der stetigen Gradsteigerung aufgebauten Qualitätensystem zwischen den *empirisch* unmittel-

¹³⁾ C. Stumpf, Tonpsychologie, 1. Bd. (Leipzig 1884) S. 184.

bar aufeinanderfolgenden Qualitäten (z.B. durch eine Verfeinerung der Unterschiedsempfindlichkeit) stets wieder weitere Qualitäten eingeschaltet denken. Die durch das Prinzip der stetigen Gradsteigerung verbundenen Qualitäten folgen einander also nur empirisch, nicht wie die Anzahlen zugleich strukturiesetzlich unmittelbar nach. Die strukturiesetzliche Möglichkeit von phänomenalen Zwischenstufen zwischen den empirisch einander unmittelbar folgenden Gliedern des Systems ist also die Besonderheit des Aufbauprinzipis der stetigen Gradsteigerung.

Die strukturiesetzliche Möglichkeit von Zwischenstufen muss aber von ihrer empirischen Wirklichkeit wohl unterschieden werden. Abweichend vom mathematischen Begriff des Kontinuums gibt es in der stetigen Gradsteigerung des *phänomenalen* Kontinuums ebenso „unmittelbare Nachfolger“ wie in der lückenlosen Grössensteigerung des Systems der Anzahlen nach dem Prinzip $+ 1$. Dass die einander im Kontinuum unmittelbar folgenden Gradabstufungen keine diskrete „Anzahl“ bilden, sondern „zusammenhängen“, ist eben die Besonderheit der durch stetige Gradsteigerung entstehenden *kontinuierlichen* Mannigfaltigkeit.

Wir brauchen nur ein phänomenales Kontinuum *an beliebiger Stelle* scharf zu teilen, z.B. das räumliche Kontinuum einer rechteckigen Fläche durch eine Farbendiskontinuität in eine schwarze und weisse Teilfläche zu zerlegen, um uns an den Grenzstellen der Teilkontinuen, die keinen Nachfolger bzw. keinen Vorgänger haben, der unmittelbaren Aufeinanderfolge der Qualitäten im Kontinuum bewusst zu werden. Die weisse Teilfläche des Rechteckes beginnt an den Raumstellen, die den letzten noch von Schwarz erfüllten Stellen unmittelbar nachfolgen. Die Teilflächen liegen phänomenal „unmittelbar nebeneinander“, indem z.B. in der ganzen Höhe der Gesamtfläche die stetige Breitensteigerung an den Grenzstellen der Teilflächen fortgesetzt wird. Ebenso beginnt ein *legato* („verbunden“) gespielter zweiter Ton an der Zeitstelle, die der letzten noch von der Qualität des ersten erfüllten Stelle phänomenal unmittelbar nachfolgt. Die benachbarten Töne folgen durch stetige zeitliche Gradsteigerung „unmittelbar nacheinander“. Würden sie es nicht tun, so würden wir kein zeitliches Kontinuum, sondern ausser dem Qualitätensprung auch einen Zeitsprung erleben.

Das Phänomen der zeitlichen oder räumlichen *Berührung* von Teilkontinuen besteht gerade darin, dass sie durch Fortsetzung der zeitlichen bzw. räumlichen Gradsteigerung einander unmittelbar, d.h. ohne phänomenale Zwischenstellen, nachfolgen¹⁴⁾.

Eine adäquate Beschreibung der erlebten kontinuierlichen Mannigfaltigkeit, die das phänomenale Kontinuum darstellt, und ihre Unterscheidung von der phänomenalen „Einfachheit“ wird erst durch die klare Erkennung der stetigen Gradsteigerung als des gemeinsamen phänomenalen Aufbauprinzips aller Kontinuen möglich. In der bis dahin bestehenden Unfähigkeit, die Eigentümlichkeit des phänomenalen Kontinuums zu beschreiben, äussert sich die ganze Unbeholfenheit einer Wahrnehmungspsychologie, die wenigstens prinzipiell nur *eine* Grundklasse von „Sinnesinhalten“, die Empfindungsqualitäten und ihre „Attribute“, kennt und die zweite Grundklasse der sinnlichen Wahrnehmungsphänomene, die qualitätenverbindenden Steigerungsphänomene, übersieht. Nicht erst bei der Analyse der Wahrnehmungsgestalten im engeren Sinne, sondern schon bei der Analyse des phänomenalen Kontinuums zeigt sich die Unzulänglichkeit dieser Art von synthetischer Psychologie.

So schreibt ein Altmeister phänomenologischer Analyse auf dem Qualitätengebiet wie Carl Stumpf in seiner Tonpsychologie über das phänomenale Kontinuum¹⁵⁾: „Wir pflegen dem Tongebiet auch *Stetigkeit* oder *Kontinuität* zuzuschreiben. Die Tatsache, um die es sich hier handelt, bezieht sich offenbar auf die Aufeinanderfolge von Tönen. Diese ist in einer zweifachen Weise möglich, diskret und kontinuierlich. . . . Das Charakteristische aber des stetigen Übergangs liegt darin, dass zwei Töne nicht unmittelbar auf einander folgen, dass aber auch nicht eine Mehrheit von Tönen, sondern nur Einer zwischen ihnen eingeschaltet liegt, dessen qualitative Grenzen jene sind. Wo immer zwei Töne *m* und *n* gegeben sind, da lässt sich, meinen wir, durch äusseren Reiz oder auch in der blossen Phantasie eine Tonvorstellung *X* erzeugen, welche mit *m* beginnt und mit *n* endet, ohne dass während der Dauer dieses *X* eine Mehrheit aufeinanderfolgender Töne in der Empfindung oder Vorstellung

¹⁴⁾ Vgl. über Grenze, Kontur und Berührung, O. Selz, Gestalten und Steigerungsphänomene a.a. O. II § 7 und § 8.

¹⁵⁾ Tonpsychologie, 1. Bd. S. 183 f.

abliefe. Wenn *e* in *g* stetig übergeht, so kann nicht eine endliche Zahl von Tönen dazwischen liegen, sonst wäre der Übergang eben nicht stetig, aber auch nicht eine unendliche, was schon an sich absurd wäre. Es ist also Ein Ton, aber freilich keiner wie *c* und *g*; sondern ein Ton *sui generis*, darum oben als *X* bezeichnet, oder Kurz und doch am genauesten: eine Tonbewegung."

Die „Tonbewegung“ des akustischen Kontinuums ist ebenso wenig „Ein Ton“ wie die räumliche Bewegung „Ein Ort“ ist. Beide sind vielmehr stetige Gradsteigerungsphänomene, bei denen mit der stetigen Zeitsteigerung in einer Falle die stetige Gradsteigerung der Tonhöhe oder Lautheit, im anderen Falle die der Ortsqualität, der Höhen-, Breiten- oder Tiefenqualität, oder aller drei Komponenten, einhergeht. Die phänomenale Verbindung der stetigen Zeitsteigerung mit der stetigen Gradsteigerung eines anderen Moments, der „Sinnesqualität“ (im engsten Sinne), der „Intensität“ oder der „Ortsqualität“, baut hierbei das *anschauliche Phänomen der „Geschwindigkeit“* der Tonbewegung bzw. der räumlichen Bewegung auf. In Übereinstimmung hiermit variiert die phänomenale Geschwindigkeit nach dem *phänomenalen Anteil* der beteiligten Steigerungsphänomene, d.h. bei konstanter Grösse der stetigen Qualitäts-, Intensitäts- oder Ortsvariation nimmt die phänomenale Geschwindigkeit bei abnehmender Dauer zu und bei zunehmender Dauer ab. Die Vereinigung der *strukturgesetzlichen* Unendlichkeit der Gradabstufungen bei der stetigen Gradsteigerung mit ihrer *empirischen* Endlichkeit aber beseitigt die theoretischen Schwierigkeiten, die Stumpf veranlassten, dem phänomenalen Kontinuum die Zusammengesetztheit und damit den Charakter der kontinuierlichen *Mannigfaltigkeit* abzusprechen, und daher im Hinblick auf seine vermeintliche „Einfachheit“ ein phänomenales Ganzes als Unterfall einer Qualität (Ton *sui generis*) zu behandeln.

Es handelt sich hierbei nicht um eine zufällige Ansicht, sondern um eine logische Konsequenz aus den Grundvoraussetzungen der *älteren* synthetischen Psychologie. Dies ergibt sich daraus, dass die in problematischer Hinsicht wegweisende „Psychologie der Veränderungsauffassung“ William Sterns einen in dem hier wesentlichen Punkte sehr ähnlichen Beschrei-

bungsversuch des phänomenalen Kontinuums enthält¹⁶⁾. Stern unterscheidet gewisse Empfindungseigenschaften, die jeder Empfindung zukommen: Intensität, Qualität, Zeitlichkeit, wahrscheinlich auch Oertlichkeit, andere wiederum, die nur gewissen Gattungen von Empfindungen zukommen, wie die „Räumlichkeit (Extension)“ und den „Übergangscharakter der Empfindung“, den er der Kürze halber auch als „Übergangsempfindung“ bezeichnet. Die beiden Hauptfälle, in denen er einen solchen Übergangscharakter für gegeben erachtet, sind erstens „der schnelle, aber stetige Übergang eines Tones in einen anderen, wie er an Pfeifen, Streichinstrumenten, leicht erzeugt werden kan“, und „der sich von der Wahrnehmung eines konstant bleibenden Tones und auch von der Wahrnehmung einer erst allmählich merkbar werdenden Aenderung ganz wesentlich unterscheidet“; zweitens die bei „genügender Geschwindigkeit“ wahrgenommene stetige Intensitätsänderung, z.B. die stetige Helligkeitsänderung. Stern beschreibt nun diesen „Übergangscharakter der Empfindung“, als „eine eigentümliche verworrene Modifikation der Intensität bzw. Qualität, infolge deren dieselbe nicht durch einen Punkt der Intensitäts- oder Qualitätsskala, sondern nur durch eine, wenn auch kleine Strecke bestimmt werden kann, während der *Konstanzcharakter* dort vorhanden ist, wo Intensität und Qualität in voller Schärfe und Distinktion auftreten.“ So wird aus dem stetigen Gradsteigerungsphänomen, das unter günstigen Bedingungen seiner Wahrnehmung an sinnlicher Klarheit hinter den „Qualitäten“ und „Intensitäten“ nicht zurücksteht, wieder eine „Modifikation“ der „Qualität“, bzw. „Intensität“ der Empfindung, eine „verworrene“, aber phänomenal „einfache“, „elementare Empfindungsnuance sui generis.“

Die vermeintliche Verworrenheit der kontinuierlichen Veränderungswahrnehmung liegt zum Teil an den für die Beobachtung stetiger Veränderungen ungünstigen Versuchsbedingungen, unter denen W. Stern solche Phänomene bei der Helligkeitswahrnehmung untersucht hat. W. Stern wählte nämlich solche Fälle, in denen die kontinuierliche Veränderung nicht objektiv ist, sondern nur vorgetäuscht wird. Ebenso verfuhr später Max Wertheimer bei der kontinuierlichen Ortsveränderung, d.h. der

¹⁶⁾ 2. Aufl. (Breslau 1906) § 2 Momentane Uebergangswahrnehmung.

Bewegung. In solchen Täuschungssfällen stehen aber die Phänomene an sinnlicher Klarheit oder „Ausgeprägtheit“ mehr oder weniger weit hinter den unter optimalen Bedingungen zustandekommenden und objektiv begründeten kontinuierlichen Veränderungsphänomenen zurück. In erster Linie aber wird die Verworrenheit der Sinnesdaten durch eine Begriffsbildung vortäuscht, die von der hergebrachten Einstellung der Sinnespsychologie auf „Qualitäten“ und „Intensitäten“ nicht loskommen kann. Zugleich bleibt diese Begriffsbildung einem ursprünglich in der Logik beheimateten *Relationsbegriff* verhaftet, der bei der phänomenalen Verbindung der Qualitäten durch sprunghafte Gradsteigerung die Schwierigkeiten noch einigermaßen zu überbrücken vermag, dem Phänomen der stetigen Gradsteigerung auf räumlichem und zeitlichen, qualitativem und intensiven Gebiet gegenüber aber vollständig versagt¹⁷⁾. Hierdurch entstand eine unüberbrückbare Kluft zwischen den Qualitäten und den Kontinuen, die dann in der Lehre der „Gestaltpsychologie“ vom „Primat des Ganzen“ zur grundsätzlichen Ablehnung jeder synthetischen Psychologie führte. Es ist kein Zufall, dass die sogenannten „Übergangsempfindungen“ und zwar die stetige Ortsveränderung oder Bewegung den historischen Ausgangspunkt dieser Entwicklung bildeten¹⁸⁾. Der Nachweis der stetigen Gradsteigerung als gemeinsames Aufbauprinzip aller phänomenalen Kontinuen und als gestaltendes Prinzip in ihnen bedeutet also zugleich einen Revisionsgrund in Sachen einer synthetischen Psychologie der Ganzen.

Die Unmöglichkeit, der *Kontinuität der echten Veränderungswahrnehmungen* mit dem Begriffsschema von „Qualitäten“ bzw. „Intensitäten“ und „Relationen“ zwischen ihnen gerecht zu werden, hat William Stern dazu verführt, diese nach seiner Meinung verworrenen Modifikationen der Empfindung als blosse „Übergangszeichen“ anzusehen, die „keinesfalls wirkliche und direkte Wahrnehmungen von Veränderungen sind. Vielmehr werden sie“ nach W. Stern „als auf Veränderungen sich beziehend *gedeutet* und können in diesem Sinne lediglich dadurch *gedeutet* werden, dass sie oft mit anderen direkten Ver-

17) Vgl. O. Selz, *Gestalten und Steigerungsphänomene*, a.a.O. I.

18) M. Wertheimer, *Experimentelle Studien über das Sehen von Bewegung*, *Zeitschrift für Psychologie* 61 (1912).

änderungswahrnehmungen zusammen aufgetreten sind." Die „direkte Veränderungswahrnehmung" aber sieht Stern in der „allmählichen" Veränderung, deren Kontinuität ganz im Sinne der erwähnten Definition von Ebbinghaus (§ 7) als ein Übergang durch unmerklich verschiedene Zwischenstufen gekennzeichnet wird. Als allgemeines Schema für die Kontinuität der allmählichen Veränderung stellt Stern nämlich die Formel auf:

$$a = b, b = c, c = d, d = e, e = f, f = g,$$

aber a verschieden von g ¹⁹⁾.

So entsteht die paradoxe Konsequenz, dass der „Eindruck der allmählich zunehmenden Dämmerung" von Stern als Beispiel einer wirklichen und direkten Veränderungswahrnehmung angeführt wird²⁰⁾, während das erlebte rasche Ansteigen der Helligkeit oder Tonhöhe und die gesehene Bewegung, die der aufgestellten Kontinuitätsformel nicht entsprechen, nur „Übergangszeichen" darstellen sollen, die im Sinne jener „direkt" wahrgenommenen Veränderungen „gedeutet" werden.

Infolge einer Fehlanalyse des phänomenalen Kontinuums werden also in den für die Psychologie der Veränderungswahrnehmung bahnbrechenden Untersuchungen von W. Stern gerade jene Fälle als Beispiele direkter Veränderungswahrnehmung behandelt, in denen die das echte Kontinuum aufbauende stetige Gradsteigerung durch Konstanzphänomene verhindert oder wenigstens gestört wird, sodass die Stetigkeit der Veränderung nur erschlossen werden kann (§ 7). Erst die Analyse der *phänomenalen Verbindungsweisen* und unter ihnen der einfachen und *mehrfachen* stetigen Gradsteigerung liefert auch den Schlüssel zum Aufbau der *echten Veränderungsphänomene* mit ihrer spezifischen Ganzeigenschaft der *Geschwindigkeit* als einer anteilmässigen phänomenalen Synthese der Grösse der stetigen Zeitsteigerung (Grösse der Dauer) mit der Grösse der stetigen Gradsteigerung auf räumlichem qualitativen oder intensiven Gebiete (Grösse der Ausdehnung im weiteren Sinne)²¹⁾.

So erfüllt die Analyse der beiden Grundarten der phänome-

¹⁹⁾ a.a.O. § 1.

²⁰⁾ a.a.O. S. 38.

²¹⁾ Vgl. die ausführliche Analyse des Geschwindigkeitsphänomens bei der räumlichen Bewegung in Beitrag 1.

nalen Verbindungsweisen der Gradsteigerung und der Wiederholung, eine doppelte Aufgabe. Sie gestattet es uns auf der einen Seite, die *fünf allgemeinsten Ganzeigenschaften*, die wir im gegliederten Kontinuum sämtlich vereinigt finden, auf *phänomenale* Aufbauprinzipien zurückzuführen, während sie sowohl die *Assoziationspsychologie* wie die *Gestaltpsychologie* ausschliesslich aus *dynamischen* Prinzipien erklären zu müssen glaubte²²⁾: Es sind Einheit im Sinne der *unitas multiplex*, der Einheit in der Mannigfaltigkeit, *Grösse*, und *Ordnung* der Ganzen, *Zusammenhang* und *Gliederung*. Auf der anderen Seite zeigt uns die Analyse derselben phänomenalen Verbindungsweisen den Weg, die spezifische Ganzeigenschaft der *Geschwindigkeit*, durch die sich die unter dem Namen der *Veränderungsphänomene* zusammengefassten phänomenalen Kontinuen auszeichnen, als eine aus der Verbindung der Zeitsteigerung mit anderen Gradsteigerungsphänomenen entstehende Besonderheit gleichfalls in ihrem Aufbau verständlich zu machen. In diesem Doppelerfolg phänomenologischer Analyse bestätigt sich die Fruchtbarkeit des Ausgangspunktes der synthetischen Psychologie der Ganzen.

²²⁾ Vgl. Beitrag 1 und O. Selz, Les problèmes génétiques de la Totalité et le problème phénoménologique de la Construction des Touts et des Formes (traduit par P. Guillaume). Journal de Psychologie XXXIIIe année p. 88 ff.

THE SUBJECTIVE DURATION OF TIME-INTERVALS. I

by

DR. OTTO ROELOFS and PROF. DR. W. P. C. ZEEMAN

CONTRIBUTION TO THE KNOWLEDGE OF THE SENSE OF TIME

- A. Introduction.
- B. Data from the literature.
- C. Personal investigations.
- D. Conclusions and speculations.

A. *Estimation of duration of intervals with interruption.*

In the course of former research-work in the territory of seeing, perceptions of light and darkness and brightness, of rivalry-phenomena, (Roelofs and Zeeman), of depth-perception (de Favaugue-Bruyel), stereo-effect, colour-perception (Colenbrander), apparent movement and movement-perception (Roelofs and Van der Waals) we were already repeatedly necessitated both in the experiment and in the interpretation of its results to take *time-factors* into consideration. We got to know the significance of the time-factor with regard to *the objects presented*; we also learnt with regard to the impressions and perceptions received to distinguish and compare time-factors in the sense of a beginning and an end and of a *certain duration* and to look upon these as being of importance. Thus we were led to devoting our special attention and experiments just exactly to the latter time-factors.

In this investigation of the time-accents peculiar to optical perceptions, among which *the duration of an optical perception* is one of the most striking, we first of all put ourselves the question what influence the contents, and more especially the *interruption* of a certain perception in a given interval may exert on the estimation of the duration of the whole interval. It is of course necessary in any investigation as to the influence of some factor or other to eliminate as much as possible all other factors which might influence the result; those factors

which cannot be eliminated should be taken into consideration in working out the results. Every interval has a *limitation*. If out of our own observation with our visual organ we want to estimate the duration of a certain physical occurrence, a continuous light-phenomenon, the physical occurrence is limited by the beginning of the light-stimulus on the one hand and the end of the light-stimulus on the other hand; the apparent duration or the visible interval is limited by the moments of appearance and disappearance of the light-perception. In case we want to judge of a so-called vacant interval, the moments of disappearance and reappearance of, for instance, a light-perception, also form the limits enclosing this vacant interval. Should an interval caused by a continuous stimulus be interrupted, the disappearance and reappearance of the light-perception determine the limits of the vacant interval raised within the limits of the light-interval. This disappearance and appearance of the light-perception manifest themselves as and may also be looked upon as being rather strong psychical stimuli. Should the interruption continue for a long time, i.e. should it arise shortly after the beginning of the whole light-interval and cease shortly before the end of this interval, then the whole occurrence presents itself as a vacant interval limited by two strong stimuli; the original light interval seems to have been broken up into two stimuli limiting a vacant interval, or the interval itself seems to be limited by these two stimuli. From one thing and the other it is clear that we must face the influence of *the kind of limitation* of the interval to be estimated.

In the second place the estimation of the duration may be dependent on the *contents* or on the filling-up of the interval. This is what we expect; otherwise we should not look into the matter of the influence of an interruption.

In this connection it may be observed that the interruption as such, both physically and physiologically, does indeed seem to be negative in character, at least on the optical part, but is no doubt bridged both physically and physiologically from another part, so that a positive character is also due to it.

Besides the interruption as such, influence may also be exerted by the physical occurrence, resp. the perception, which is interrupted, as well as all that (inclusive of the perception) which takes place during the interruption, i.e. during the so-called

vacant interval. We shall also have to pay attention to this point.

In the third place we shall have to find out whether the interruption of an interval of objectively *shorter* duration gives other results than the interruption of an interval of objectively *longer* duration. In an interval of short duration the limiting stimuli will dominate physiologically and will also bespeak our attention; in an interval of long duration, on the other hand, everything enacting itself within its limits, will make itself felt; the contents of the interval will chiefly draw our attention. It goes without saying that we are entitled to suppose that an interruption of those contents in the latter case will be of greater influence.

In the fourth place the estimation of the duration of a perception is only possible by *comparing* the duration of this perception with the duration of another simultaneous perception or by comparing the duration of the perception with the duration of a previous perception. In the first case it is customary to speak of measurement, of direct comparison, of establishing the fact of coincidence or non-coincidence in time; in the second case we speak of estimation of duration in a narrower sense; the two perceptions we want to have compared are raised after each other and are then judged of and compared. It is very much the question whether in comparing the duration of two successive intervals the former interval is judged of in the same way as the latter interval so that we shall have to pay attention to *the order of the intervals presented*.

In the fifth place the two successively obtained perceptions will either be able to succeed each other immediately or they will be separated by a break. It is not excluded that *the duration of this break* will make its influence felt on comparing the successive perceptions.

B. *Data from the literature.*

We shall now trace what we have found in the literature about the influence of the above-mentioned five factors.

1. *The influence of the limiting stimuli.*

According to Meumann, Benussi and others the influence of the limiting stimuli is strongest with short periods of time. Van der Waals and Roelofs write that they are inclined to assume that the filling stimuli are ousted by the strongly accentuated

limit-stimuli, so that the link between these limiting stimuli is more easily brought about. The significance of intensity and quality of the limiting stimuli (perceptions) can be investigated in several ways. An obvious method is having two periods of time limited by rustlings of different strength successively compared with each other; this may be represented by 1—2, 3—4. Now either 1 and 2 may be more strongly stressed (1'—2') or 3 and 4 (3'—4'). According to Meumann in both cases the second interval, i.e. from 3 to 4 is perceived for a shorter time; viz. in the former case as 1'—2'...3. 4 and in the latter as 1—2...3'. 4'. It does not seem permissible to conclude from this that the intensity of the limiting rustlings would be of no influence at all; one had rather infer from this that in comparing two short intervals without regard to the intensities the latter is estimated as being shorter than the former.

The second interval is not always estimated as being shorter, however. If only the first rustling should be more strongly stressed and if the proportion of the stimuli should be 1'—2...3—4, this would be perceived, according to Meumann at least, as 1'. 2...3—4. The latter proportions remind one of a clock with irregular stroke, in which the link between the irregular strokes is more conspicuous than would be the case with regular strokes.

With regard to the former fact that the intensity of the limitation would seemingly be of no influence, Benussi came to another result than Meumann; just as Kretz he found that in short periods of time a limitation by more intensive sounds makes these periods seem longer; in long periods of time, on the contrary, they seem shorter. He ascribes this to the fact that in comparing short periods of time more attention is paid to the limiting rustlings and that consequently the intensity of the rustlings is involuntarily transferred to the judgment of the duration. This explanation seems to be unfounded.

With regard to the second fact that a stronger stressing of the first rustling shortens the apparent duration, Benussi came to the same result as Meumann; besides he found that strengthening of the final rustling only considerably *lengthened* the apparent duration. Shortening in the former case is slighter than lengthening in the latter. According to Benussi both shortening and lengthening are based on a longer „Gegenwartszeit” of the

stronger rustling. With a stronger incipient rustling the apparent shortening of the interval will be partly cancelled again, because of the interval being more strongly stressed by contrast.

According to Meumann and Von Kries a longer series of strong sounds gives the impression of greater rapidity than a corresponding series of weak sounds, which would probably be connected with the greater tendency to fusion of the stronger sounds. In analogy with the above discussion on the significance of a strong stressing of incipient or final rustling as to the estimation of the duration of intervals it might also be interpreted in this sense that in each of the whole series of successive intervals the intensity of the incipient rustlings every time shortens the estimated duration while, in addition to this, each of the successive intervals would once more show that stressing the final rustling lengthens the interval, which will have to lead to a closer union of the successive representatives of the series within a certain period of time into apparently greater rapidity. To put it more simply the longer „Gegenwartszeit” of the stimuli makes the intervening interruptions seem shorter.

Besides Van der Waals and Roelofs remark about this question that the opinion of Von Kries that the phenomenon would be ascribable to an easier manifestation of fusion with stronger stimuli cannot be accurate, as the experiments of Hylkema have proved the contrary. They add to this that fusion manifests itself if the intervals are filled up by a longer duration of the perceptions of the stimuli; that shortening takes place, however, if the intervals are bridged or ousted, and consequently are not filled up, but partially fall away.

A highly interesting series of experiments was made by Meumann with three sound-stimuli, in between which lay two equal short intervals (smaller than 600 σ). One or two of these sound-stimuli were more strongly stressed. The result may be indicated as follows:

Objective relation	Subjective relation
1' - 2' - 3	1.2. - 3
1 - 2' - 3'	1 - 2.3
1' - 2 - 3'	1 - 2.3
1 - 2' - 3	1 - 2.3
1' - 2 - 3	1 - 2.3
1 - 2 - 3'	1.2. - 3

Now it is quite well possible to ascribe the way in which the three sounds are heard to rhythmification, but this is only another word for the same phenomenon. It gives the impression that the link between two equally strong stimuli is greater than between unequally strong stimuli and that there is more tendency to link 2 and 3 than 1 and 2. The third stimulus is bound by 2 preceding ones; the second only by 1.

This easier link of two equal stimuli does not remain limited to the intensity; the same was found in equal pitch, $c - e - e$ (interval 400 σ) was heard as $c - e.e$; and with equal localization, $1_1 - 1 - 1$ (interval 200 σ) was heard as $1_1 - 1.1$.

Especially with $1_1 - 1 - 1$, in which 1_1 points to another localization or another direction of the sound than 1, the rhythmification was very striking, though the sound was perfectly equal. As in hearing in different directions we may and must think of these directions as linked to different motoric impulses, one might say that the link is strongest, if the physiological constellations of the motoric impulses roused by the stimuli are most equal to each other, are enacted in anatomically and physiologically neighbouring regions, and if the jump between the two constellations is but small. If the interval becomes larger the motoric constellation pertaining to the first stimulus will gradually alter, owing to which the difference with the motoric constellation pertaining to the second stimulus will also increase; it will lead to a weaker link between the limiting rustles and together with this to a longer apparent interval.

We shall also be able to obtain a more rapid alteration and retirement of the whole psychophysical occurrence roused by the first stimulus by fixing our attention more on the interval itself; indeed the interval is then estimated as being longer, whereas greater attention for the limiting stimuli causes the interval to be estimated as being shorter; in this way one may arbitrarily give the preference to a certain rhythm.

Consequently a similar rhythmical impression may arise through: differences in intensity, in quality, in localization, in duration of the intervals and in subjective stressing.

For the sake of completeness we may add here that according to Meumann two sound-stimuli (interval 50—500 σ) seem to succeed each other more slowly than a series of sound-stimuli with a similar interval. If in a series of sound-stimuli one of the

stimuli is strengthened, the preceding interval seems shortened, the following one lengthened.

Of great interest is the fact that with intervals of less than 400 σ , the interval between two light-stimuli seems longer than between two sound-stimuli and this, in its turn, longer than between two touch-stimuli, at least if one has selected spots of the skin with delicate touch-sense. Should one first give two light-stimuli after each other and then with the same interval a touch-stimulus or a sound-stimulus, one obtains again the rhythm 1.2—3; so, here too, there is a stronger link between the equal stimuli.

Summarizing it becomes apparent that in judging shorter periods of time (600 σ) the limiting perceptions have great influence; in as much as the limiting stimuli are more equal to each other, the intermediate interval seems shorter and even the more so, if the motoric impulses to which those stimuli gave cause, are also equal.

2. The influence of the filling up or of the contents of the interval.

In the first place we can compare vacant intervals with intervals interrupted by a single stimulus of short duration. In this connection we must immediately point out that properly speaking there can be no question of vacant intervals, as indeed Meumann already rightly remarked. Also a vacant period of time, in the sense meant here, i.e. a period during which the influence of the outward sensory stimuli is interrupted, yet has a slight content for the observer in so far that from diverse organs stimuli still keep flowing to him and also organic perceptions may exist; even apart from all that which, having remained behind from a preceding stimulus, may in the form of engrammes or of reminiscences or otherwise fill up the interval of which the observer is aware. The experiments of Meumann first of all taught that the results are greatly different in proportion as one takes the intervals long or short, and further that it makes a difference whether one introduces an interruption into the first or into the second interval.

In *short* periods of time the filled-up interval is as a rule estimated to be longer and in *long* periods of time the vacant interval is generally estimated to be longer. In between these

there must therefore lie an *indifference-zone* in which the subjective conclusion answers to the objective proportions. If in the case of sound-stimuli the interrupting stimulus lies in the first interval, the *indifference-zone* lies between 1800 and 2500 σ .

The situation of the indifference zone does not only vary individually, but is also dependent on the nature of the stimuli (touch-, light-, sound-stimuli) on the number of filling-up stimuli, the completeness of the filling-up, on possible rhythmicization and on the "Zeitlage" of the filled-up interval, i.e. on the order of the objects to be compared, as found expression in the related figures.

The latter factor, the "Zeitlage" seems to be of such great importance that the significance of the contents of the interval may be annulled by it and that the latter may hide itself, resp. be neutralized. Thus Schumann reports that in case of larger breaks between two equal intervals the first interval is always estimated to be greater, also when it is a vacant interval. In this connection it is remarked that the great break would fatigue and would cause the attention to relax, owing to which the fourth signal surprises and the interval between third and fourth signal is consequently estimated as being shorter. If one causes the third signal to be preceded by a warning sign, the under-estimation will not take place.

It may be, however, that the third signal by being linked to the warning signal is detached from the fourth signal and causes a lengthening of the second interval.

Benussi found the contrary and also came to other conclusions and another interpretation; we may leave this alone here as being of no importance regarding the question whether filling-up with a single stimulus has greater influence in the former or in the latter interval.

To this Meumann gives the answer. The filling-up with a single sound-stimulus may both in the former interval (N.Z.) and in the latter interval (V.Z.) with very short periods of time give over-estimation of the filled-up interval. This cannot really astonish us as the link between the two limiting stimuli is disturbed by the interrupting stimulus. If we make the intervals longer we sooner reach the "indifference-zone" in filling up the second interval, so that there are circumstances in which the filled-up former interval is overestimated and the filled-up

latter interval is underestimated. Consequently the influence of the filling-up of V.Z. is weaker than that of N.Z. Neither is the fact that in longer intervals the interrupting stimulus makes the interval seem shorter very surprising, if one considers how this can bridge the two limiting stimuli, for in longer intervals also perceptions roused from elsewhere claim our attention, which disturbs the link of the limiting stimuli; an inserted interrupting stimulus may favour this link and thus will be able to give an apparent shortening.

Meumann still points out that in *rhythmification* overestimation may easily be converted to underestimation. Stanley Hall and Mastron everywhere found overestimation of the filled-up periods of time (1—2"), if the intermediate breaks were very long or very short (750 σ); they, too, are of opinion that the influence of the filling up is greatest in the first interval, so when the vacant period of time follows.

Finally Meumann remarks, and this seems indeed highly important to us, that the influence of the filling-up, *also with the same observer*, can greatly vary. This might be accounted for by the fact that sometimes more attention is paid to the limiting perceptions and then again to the perceptions during the interval. As the former is especially the case with shorter and the latter with longer periods of time, the same explanation might also hold good with respect to the existence of the „Indifference-zone”.

In case the interval is not filled up with a single one, but *with more stimuli* the overestimation of the short interval becomes still stronger and the indifference-zone only manifests itself in much longer periods of time, according to Meumann in 4500—10.000 σ . This overestimation becomes slighter, if the first and the final rustling are more strongly stressed. Strengthening of the whole series of stimuli gives an apparent shortening as compared with a series of weaker stimuli (Meumann, Von Kries).

With longer intervals a change manifests itself in this respect. According as the happenings are more differentiated, the link of the whole interval becomes a looser one, overestimation being the consequence.

Besides *sound-stimuli* also *light-* and *touch-stimuli* give similar results. With sound- and light- stimuli there exists an optimum

of the number of stimuli for the greatest overestimation. With touch-stimuli increase of the number of stimuli, in as far as investigated, always gives increase of overestimation. We may add to this that also with a large number of stimuli, however, the overestimation decreases or disappears owing to rhythmicification.

Hüttner thinks continuously filled-up periods of time the most suitable objects for the examination as to time-sense. He made use of light-stimuli and found the most accurate estimation at 1000 σ . Disturbances might manifest themselves owing to increase and decrease of the perception, positive after-image, etc. With intervals of 300 σ and longer indirect expedients for the estimation of time are indispensable (tension respiratory organs, rustlings of electro-motor, etc.). He found no indifference-point. Also continuously filled-up periods of time are, according to Meumann overestimated with regard to long vacant periods of time (only in vacant intervals linking of the limiting-rustlings is possible).

If the filled-up time precedes, the Indifference-zone lies at 6000 σ ; if the vacant interval precedes it lies at 2000 σ . The overestimation of the filled-up interval seems therefore slighter in the latter case. If the duration of the intervals becomes still longer no reversal to under-estimation of the continuously filled-up interval will be met with. In very small periods of time (300 σ and 200 σ) the continuously filled-up interval, if succeeding the vacant interval, may also be underestimated. Starting from these small periods and making them gradually longer we shall find two indifference-zones, one when the underestimation of the filled-up interval passes to over-estimation and another when this overestimation disappears.

In this connection we should bear in mind that one has as much right to speak of an underestimation of the vacant time as of an over-estimation of the filled-up time; it seems to us that the estimation of the vacant periods of time is more unstable owing to the influence of the limiting rustlings.

In the filling-up with more stimuli one may also differentiate between *regular* and *irregular* filling-up. Grimm found that the regular filling up was judged to be longer than the irregular one. The regular division has something quiet about it, the irregular makes the impression of not being finished. In irregular

filling-up of time an interval with final accumulation of the stimuli is judged to be longer than an interval with central accumulation of the stimuli. Accumulation in the middle seems more irregular and less complete. Grimm ascribes the underestimation to "Ueberraschung", in accordance with Schumann therefore. In case one strengthens the limiting-stimuli in irregular filling-up, the difference with the regular filling-up decreases. Division brought about by a single stroke in the middle, gives a longer estimation of the interval than a dividing-stroke in the beginning or at the end; in the latter cases the overestimation disappeared. Especially in case of a dividing-stroke at the end "Ueberraschung" was reported to be distinct. In contradistinction to Grimm, Benussi always found underestimation in division by one stroke; if the dividing stroke occurred at the beginning or at the end, the underestimation disappeared. In comparing the results of Grimm and Benussi it will in the first place be necessary to take the objective duration of the intervals into account.

We once more want to repeat that according to *Meumann* the phenomena hold good for all regions of the senses, but that they change as to quantity, regularity, objective duration and rhythmification.

Experiments have also been made in which the *attention* is distracted by reading or counting. According to *Meumann* the vacant time is in the beginning reproduced as being longer. After practice the proportions change, however, at first the time spent in reading apparently becomes longer, but in further practice it becomes shorter again. It is evident from this that in this way one creates such complicated relations that we have not yet succeeded in disentangling them. Also *Katz* found that in distracting the attention by reading the interval is estimated as being smaller.

Schneevoigt made experiments in which the interval was filled up by *music* as well as experiments in which the interval was filled up in looking at statical or dynamical *images*. The results were dependent on the type of character (persons integrated outwardly or inwardly). The persons integrated outwardly were considered to possess more of an "Inhaltsuhr", those integrated inwardly more of an "Organismusuhr" (instinct of time). With the latter persons the estimation of time was said to be more

accurate. Musical filling-up was said to give underestimation. Statical images were said to give more overestimation with persons integrated inwardly; dynamical images were said to give more overestimation with persons integrated outwardly. It would seem, however, that Schneevoigt was mistaken in judging of his results.

It is remarkable that whereas Katz and Benussi are of opinion that an interval is estimated as being longer according as it draws the attention more, Grimm comes to the opposite conclusion. Grimm found that owing to the subject's counting during the regularly filled-up periods of time those periods are estimated as being shorter. He ascribes this to the attention being more strongly drawn to those periods; we think one might suppose with just as much right that by counting oneself the attention is distracted from the length of the periods.

In their first series of observations Van der Waals and Roelofs found that in continuously filled-up intervals the estimation of the first interval with regard to the second, even with rather strong change of the contents of both intervals, remains practically the same. That, nevertheless, the contents are not without significance for the estimation of the duration of intervals was shown in the second experiment-series by the fact that, under the exposition-proportions given there, the duration of the exposition of a small object was estimated as being longer than that of a large object. The result of their third series also points in the same direction, when an interval in which a large number of objects were shown was estimated as being longer than an equally long interval in which a smaller number of objects was shown. Besides the duration of exposition of intricately constructed objects was estimated as being longer than an equally long duration of exposition of objects with minimal structure, as was apparent from their fourth series of observations.

Their investigations led to the conclusion that an interval is estimated as being shorter, if the limiting stimuli chiefly draw the attention, and, on the other hand, as being longer, if this is the case with the contents.

Besides they observe that the subjective duration is apparently also dependent on the contents of the happenings on which the duration is experienced, a psychological formulation starting

from the phenomenal data. They immediately add to this, however, that the shortening of the subjective duration of perception owing to interruption or to rotation of an object in their dependence on the way of interruption or on the rapidity of rotation, founded on certain laws, point to the fact that the above-described connection between the contents of the perception and the subjective duration of the perception can only be derived from cerebral physiological causes which for the present cannot be accounted for psychologically.

Summarizing we may say that in general the filling-up of the interval leads to overestimation with regard to the vacant interval if it hampers the link of the limiting perceptions and to underestimation if it entails the factors for the formation of new links.

3. The influence of the objective duration of the interval.

It is a matter of course that an objectively shorter interval will also subjectively be estimated as being shorter than an objectively longer interval; nevertheless the way of appreciation may be different. Vierordt found that small periods of time are estimated as being too long, and long periods as being too short. The indifference-point was said to lie at 2500σ . The estimation was determined by reproduction of the time to be appreciated. We should not forget, however, that the error may also lie in the reproduction, owing to longer reproduction-periods being estimated as being too short in consequence of processes preceding or attending the arbitrary tact?-movement. Stevens, who used another method of investigation, found, indeed, that smaller intervals were estimated as being too small and larger ones as being too large. Intervals of from $530-870\sigma$ were correctly reproduced. Nichols found that the intervals of 750 , 500 and 250σ were reproduced shortened and the intervals of 1250 and 1750σ lengthened, more in accordance with Stevens, therefore. But also these methods, just like those of Vierordt have a fundamental error.

The indifference-point is also recorded in various ways. Mehner found this periodically returning and that at 700 , 2150 , 3530 and 5000σ , always with an odd multiple of 710σ , therefore. Stern wants to explain the indifference-point from the size of

the "Zeithof", whereas Külpe is of opinion that the indifference-point lies in a place where one way of judgment of time passes into the other way of judgment of time. One would not be able, however, to account for the periodicity in this way; consequently Münsterberg expects the cause to be found rather in the periodicity of respiration, which, according to him, is of very great importance to the estimation of time.

Perhaps Meumann was the first emphatically to point out that the perception of short and long periods of time is brought about in various ways. Katz, too, speaks of short, agreeable "angemessene" time and of long time.

The "appropriate" time will probably agree with the so-called adequate order of metronome-beats, which, according to Schumann, occurs if the attention can easily prepare itself for the next beat. Vierordt found for this adequate time 640 σ , Schumann 600 σ , whereas Meumann indicates that above 500 σ and 600 σ the interval itself gains more importance with regard to the judgment of time. Katz, too, comes to the conclusion that the time-experiences of different kinds are separated by the duration of 500—600 σ (angemessene Zeit). With a duration of from 650—2900 σ the simultaneous gathering up of two limiting rustles is still arbitrarily possible, according to Katz, in some cases even up to 3600 σ . One experiences some tension, however, in holding fast the first rustling. For the judgment of shorter and longer periods of time Benussi also took numbers linking up with the above conceptions and that for short periods of time: 360 σ , for intermediate periods of time: 720 σ , and for long periods of time 1440 σ , Katz still remarks that the "anschaulich erlebbare Zeit" shows large oscillations; these oscillations are individual and further depend on the expectation, preceding intervals (adjustment), fatigue etc. Estel took as largest interval to be caught "einheitlich" a duration of 5000 σ , while James is of opinion that the "Präsenzzeit" may amount up to 12000 σ ; these long periods seem to be questionable, however.

Now as to the judgment of short periods of time we already find with Wundt that estimation of time is only brought about immediately with intervals smaller than 500 σ .

In this connection we just want to call to mind the perceptions and ideas of Schultze. He remarks that a succession of acoustic stimuli can evoke different perceptions. With an interval smaller

than from 60—100 σ we either have vibration-phenomena or complete fusion, with an interval of from 100—350 up to 400 σ we get so-called *collektion* symptoms (in inaccurate cases even — 550 up to 600 σ) and with intervals of from 440—880 σ subjective unity is still perceived.

In the vibration-phenomena the sound-perception of the preceding stimulus has not yet disappeared, when the next begins. In the *collektion* phenomena the sound of the first stimulus is still fully present in our consciousness at the beginning of the second; the "extent" of consciousness of acoustic beats of average intensity was said to amount to 300—350 σ . According to Schulze optical *collektion* phenomena were found to be much weaker than acoustic ones. With the subjective unity the sound of the second stimulus only makes itself heard on decreasing attention to the first stimulus; nevertheless the stimuli are still involuntarily linked by the observer. Perhaps one might also express this in the more physiological terms that the reactions roused along the sense-organ concerned, resp. cortical area still dominate the competing impulses coming from other areas, resp. parts of the brain. A whole attention-step would at most amount to 900 σ .

According to Benussi with intervals shorter than from 500—600 σ the judgment goes together with the greater difficulty in seeing the two limiting perceptions separately; this strenuous analysis-work will be all the greater and the time will seem all the shorter according as the second limiting perception lies more towards the beginning of the "Zeithof" of the first limiting perception.

So as with smaller periods of time we rather have a judgment of the succession of perceptions, thus according to Meumann, Benussi and others, the judgment of the duration of the intervals will be substituted for this with longer periods of time. In proportion as the interval, the Z.-component of Benussi, is more striking, the time becomes apparently longer.

The recent investigations of Van der Waals and Roelofs have also shown once more that the length of the intervals is of importance to the way of judgment. They ascertained that if one shortens the objective exposition-periods with the subject who estimates the second interval as being longer, the results become different and the first interval is estimated as being

longer. In proportion as the exposition-periods are shorter there is more inclination to estimate the second exposition-period as being shorter; in proportion as the exposition-periods are longer there is more inclination to estimate the second exposition-period as being longer. Consequently they found an indifference-zone in which equal periods of exposition were also estimated to be equal, which, with the subject concerned, had to lie in an exposition-time of 622 σ , which agrees with the so-called adequate time.

Here, too, a formulation in partly physiological terms forces itself upon us and one would perhaps be entitled to say that in proportion as the stimuli from one sense-organ, the innervations from one cortical area go on dominating in the system or are temporarily interrupted and ousted from other areas, the data for the judgment of time are others, the intervals are estimated as being shorter or longer.

4. Influence of the order of the two comparison-objects.

Above we have already mentioned that according to Meumann the filling-up of the first interval gives a stronger apparent lengthening than the filling-up of the second interval. He ascribes this to the first interval being perceived differently from the second.

Schumann finds that with larger breaks and two vacant intervals of the same duration the first is estimated as being longer. Probably this is only partly correct, for Münsterberg found this overestimation of the first interval only with very short periods of time, which is more or less in agreement with the experiences of Grimm, who with an interval of 750 σ and one of 7500 σ also found overestimation of the first interval, but with intervals of from 1000—3000 σ , overestimation of the second interval. Also Benussi found overestimation of the second interval and is of opinion that this only occurs with longer periods of time. He ascribes this to the second interval being considered with greater attention and to the time-component being paid more attention to especially with longer periods of time. According to him the second interval is perceived most accurately, so that the estimation of the first interval is rather to be called faulty. Schumann's Expectationtheory is rejected by him. In contradistinction to

Benussi, Grimm is of opinion that with increasing duration of time the influence of the order (Zeitlage) decreases again.

Katz found that with breaks longer than 1800σ and intervals of short duration the second interval is underestimated and that with intervals of longer duration the second interval is overestimated. Adequate time occurs at 600σ . The difference in opinions makes a new profound investigation very desirable.

Van der Waals and Roelofs have devoted a special investigation to this question and as the result of their first series of observations in which the contents of the first and those of the second interval were always equal, they determined that first and second interval are not estimated as being equally long, that in this respect there are individual differences and that one cannot but assume that these differences are connected with one subject being more inclined to pay attention to the limiting stimuli and another to the contents of the intervals and that similar differences may exist in the way of judging the first and the second interval.

5. Influence of the duration of the break between the two intervals.

Meumann points out that for the comparison of two intervals an intermediate break is desirable, as otherwise the contents of the first interval have a disturbing influence on the judgment of the second interval. With small and mean periods of time a break of 2000σ is recommended.

The fact observed by Meumann together with his elucidation seems acceptable to those who on phenomena of apparent movement have been able to ascertain how the localization in space of an object presented may be influenced either by a preceding or by a following second stimulus.

Vierordt is of opinion that larger breaks have no influence on the comparison of time. Thorkelson, too, finds that breaks varying from $3000-7000\sigma$ gave the same results on comparing the intervals. Paneth even contends that breaks fluctuating between fractions of seconds and five minutes, are without influence. Meumann finds on increasing the break to from $15000-21000\sigma$ a slow decrease in the sensitiveness to discrimination; with even longer breaks this decrease becomes more rapid.

Schumann found that with a shorter break the second interval is estimated as being longer. Meumann and Benussi found exactly the opposite. According to Katz and Benussi a longer break or longer expectation-time would just exactly lead to overestimation of the second interval. This would especially hold good for intervals of longer duration.

According to Benussi with short intervals the attention to the limiting-rustle complex of the first interval would shift during the break to the time-distance of this interval causing its apparent lengthening. In opposition to this with longer breaks the attention is concentrated more on the second interval owing to which it is estimated as being longer. Katz is of opinion that, in proportion as the break is greater, more attention is paid to the second interval, owing to which shorter intervals seem even shorter and long intervals even longer.

The investigations of Van der Waals and Roelofs have also contributed to this point. In these it became clear to them that the break between the two exposition-periods is not quite immaterial to the judgment of the exposition-periods with respect to each other. In their first series of investigations they compared equal intervals with breaks of 1111 σ , 1333 σ , 1555 σ and found disappearance of the underestimation of the second interval in case of a longer break. According to them it is obvious that with a shorter break the stimuli are more imposing, possibly because of their being unexpected, whereas with a longer break the contents rather claim the attention, as we have prepared ourselves for the appearance of those contents. So there are also differences of opinion as to the influence of the break, which difficulty will have to be solved by further investigations.

C. *Personal investigations.*

The estimation of the duration of intervals with interruption.

In the first place we have investigated the influence of an interruption of an interval otherwise having a continuous course.

Van der Waals and Roelofs have also set the example to us in this case, for in their fifth series of experiments they

successively presented a continuously present object and an object which was for a short time interrupted. This investigation taught them that an interruption of the exposition gives an apparent shortening of the interval. Within wide limits this apparent shortening is greater in proportion as the interruption is longer. They also found that a series of interruptions gives far less occasion to an apparent shortening than does one continuous interruption equal to the sum of these interruptions.

In this investigation we made use of an imitation of Michotte's tachistoscope as altered by Godefroy¹⁾.

By means of this instrument two luminous squares with a surface of 11.5×11.5 cm² were projected on the white wall. The distance between the two squares amounted to $3 \times 11.5 = 34.5$ cm. The subject was sitting at a 2 meters' distance from the wall.

This investigation can be divided into 5 experiment-series as to the influence of an interruption.

First series.

In this first experiment-series one of the objects was exposed during 420 sigmata having in the middle an interruption of from 140 or 350 sigmata. The other object was not interrupted and was exposed during 336, 378, 420, 462 or 504 sigmata.

The break between the two expositions amounted to 210 sigmata. The interrupted object stood as many times to the left as to the right and was as many times exposed first as last.

Every experiment was so often repeated till the subject had formed a proper judgment. The subject only had to tell which of the two squares seemed to him to have been exposed longest. In this experiment-series we can distinguish between: estimation of duration between left and right, between first and last, between interrupted and uninterrupted and between interrupted for a shorter or a longer time.

For this series 800 observations in all were made.

The difference between left and right gave the following results:

¹⁾ A description of this instrument is to be found in: Van der Waals und Roelofs, *Optische Scheinbewegung*, *Zeitschr. f. Psychol.* Volume 114 and 115 (1930).

Objectively	Subjectively
Left longer: 320	Left longer: 160
Right " : 320	Right " : 181
Equal : 160	Equal : 459

The difference between left and right is comparatively slight. As each square received its light from a separate light-source, left and right square were not perfectly equal in clearness and colour. It is therefore difficult to make out which factor caused this small difference; reason why we want to confine ourselves to the fixation and the mention of the fact.

A difference of more importance was shown in the estimation of duration of the object projected first and that projected last. Here we found the following:

Objectively	Subjectively
First longer: 320	First longer: 89
Last " : 320	Last " : 252
Equal : 160	Equal : 459

A more detailed arrangement is shown in Table I.

Table I

Objectively	Subjectively	Certainty
First 84° longer: 160 420—336; 504—420	First longer: 43 Last longer : 18 Equal : 99	$25/160 = 15.6\%$ First longer
First 42° longer: 160 420—378; 462—420	First longer: 27 Last longer : 21 Equal : 112	$6/160 = 3.7\%$ First longer
First and last equal: 160 420—420	First longer: 14 Last longer : 45 Equal : 101	$31/160 = 19.4\%$ Last longer
Last 42° longer: 160 378—420; 420—462	First longer: 5 Last longer : 75 Equal : 80	$70/160 = 43.7\%$ Last longer
Last 84° longer: 160 336—420; 420—504	First longer: 0 Last longer : 93 Equal : 67	$93/160 = 58.1\%$ Last longer

It is clear that with this subject under the given proportions (duration of break and interval, etc.), there is a tendency to estimate the duration of the exposition of the first object as being shorter or that of the last object as being longer. From the results obtained we may infer that the estimation will be fairly equal if the first object is exposed 437.5σ and the last object 402.5σ , with a difference in duration of exposition of 35σ therefore. With respect to the second interval the first interval is consequently perceived as being shortened 8%.

The regular course of the numbers in Table I not only gives a guarantee as to the reliability, but teaches us at the same time that even a small difference of 42σ can very well be distinguished, also in case of successive perception.

Though we shall repeatedly point out the difference in estimation of time of the square projected first and of that projected last, we do not want to go farther into this subject till in a following investigation, which will be exclusively devoted to this question.

What is of most importance to us now is the difference in estimation of time between the interrupted and the uninterrupted object. Our investigation gave the following results concerning it:

Objectively	Subjectively
Interrupted longer: 320	Interrupted longer: 96
Uninterrupted " : 320	Uninterrupted " : 245
Equal : 160	Equal : 459

A more detailed arrangement is shown in Table II.

It is very clear that the interrupted object is subjectively seen as being shorter, the uninterrupted object is subjectively seen as being longer. From the results obtained we may infer that they are estimated as being almost equal in duration, if the interrupted object is exposed 420σ and the uninterrupted object 394σ , i.e. 26σ shorter. So with regard to the uninterrupted object the interrupted object is estimated as being 6.2% shorter. Under the given circumstances we have therefore found with this subject an unmistakable influence: 1. of the being exposed sooner or later; 2. of the being interrupted or not.

These two factors may strengthen the estimation of the time-

Table II

Objectively	Subjectively	Certainty
Interrupted 84σ longer: 160 420—336; 336—420	Interrupted longer : 34 Uninterrupted longer: 14 Equal : 112	$20/160 = 12.5\%$ Interrupted longer
Interrupted and uninterrupted 420—378; 378—420	Interrupted longer : 33 Uninterrupted longer: 17 Equal : 110	$16/160 = 10\%$ Interrupted longer
Interrupted and uninterrupted equal : 160 420—420	Interrupted longer : 16 Uninterrupted longer: 43 Equal : 101	$27/160 = 16.9\%$ Uninterrupted longer
Uninterrupt. 42σ longer: 160 462—420; 420—462	Interrupted longer : 9 Uninterrupted longer: 69 Equal : 82	$60/160 = 37.5\%$ Uninterrupted longer
Uninterrupt. 84σ longer: 160 504—420; 420—504	Interrupted longer : 4 Uninterrupted longer: 102 Equal : 54	$98/160 = 61.2\%$ Uninterrupted longer

duration as being longer or shorter in the one case and may weaken it in the other.

We may once more examine how the results are, if both factors strengthen each other and how they are, if they counteract each other, i.e. A. when the interrupted object is exposed first and B. when the interrupted object is exposed last.

The tables III and IV give us the desired information on the subject. In Table III (A) the most remarkable thing is that even a difference of 84σ is perceived wrongly. In Table IV (B) we are struck by the fact that the two factors, sooner or later, and interrupted or uninterrupted fairly balance each other so that the apparent shortening caused by the object being projected first is here as good as equal to the apparent shortening caused by the object being interrupted. This makes one ask oneself whether perhaps the apparent shortening both because of projecting first and because of interruption has a similar psycho-physiological cause. Later on we shall once more revert to this question. (Cf. pp. 36 and 45). It is certainly not correct to infer from the above that the interruption should only make its influence felt in the object projected first, as without any

Table III (A)

Objectively	Subjectively	Certainty
Interrupted 84σ longer: 80 420—336	Interrupted longer : 4 Uninterrupted " : 14 Equal : 62	10/80 = 12.5 % Uninterrupted longer
Interrupted 42σ longer: 80 420—378	Interrupted longer : 4 Uninterrupted " : 13 Equal : 63	9/80 = 11.2 % Uninterrupted longer
Interrupted and uninterrupted equal : 80 420—420	Interrupted longer : 3 Uninterrupted " : 32 Equal : 45	29/80 = 36.2 % Uninterrupted longer
Uninterrupted 42σ longer: 80 420—462	Interrupted longer : 1 Uninterrupted " : 46 Equal : 33	45/80 = 56.2 % Uninterrupted longer
Uninterrupted 84σ longer: 80 420—504	Interrupted longer : 0 Uninterrupted " : 63 Equal : 17	63/80 = 78.7 % Uninterrupted longer

Table IV (B)

Objectively	Subjectively	Certainty
Interrupted 84σ longer: 80 336—420	Interrupted longer : 30 Uninterrupted " : 0 Equal : 50	30/80 = 37.5 % Interrupted longer
Interrupted 42σ longer: 80 378—420	Interrupted longer : 29 Uninterrupted " : 4 Equal : 47	25/80 = 31.2 % Interrupted longer
Interrupted and uninterrupted equal : 80 420—420	Interrupted longer : 13 Uninterrupted " : 11 Equal : 56	2/80 = 2.5 % Interrupted longer
Uninterrupted 42σ longer: 80 462—420	Interrupted longer : 8 Uninterrupted " : 23 Equal : 49	15/80 = 18.7 % Uninterrupted longer
Uninterrupted 84σ longer: 80 504—420	Interrupted longer : 4 Uninterrupted " : 39 Equal : 37	35/80 = 43.7 % Uninterrupted longer

interruption of either object the duration of the second object was estimated as being longer under the given circumstances.

Now we have still got to find out whether the objective duration of the interruption also has any influence on the estimation of the duration of the whole. The projections with shorter and longer interruption were not directly compared with each other, but both were tested on an uninterrupted projection. We then found the following:

With an interruption of 140°		With an interruption of 350°	
Interrupted longer	: 35	Interrupted longer	: 61
Uninterrupted "	: 135	Uninterrupted "	: 110
Equal	: 230	Equal	: 229

A more detailed arrangement is shown in Table V.

Table V

With an interr. of 140°

With an interr. of 350°

Objectively	Subjectively	Certainty	Subjectively	Certainty
Interr.	Interr. longer: 13	$1/80 = 1.2\%$	Interr. longer: 21	$21/80 = 26.2\%$
84° longer: 80	Uninterr. " : 14	Unint. longer	Uninterr. " : 0	Interr. longer
420-336	Equal : 53		Equal : 59	
Interr.	Interr. longer: 15	$2/80 = 2.5\%$	Interr. longer: 18	$14/80 = 17.5\%$
42° longer: 80	Uninterr. " : 13	Interr. longer	Uninterr. " : 4	Interr. longer
420-378	Equal : 52		Equal : 58	
Interr. and unin-	Interr. longer: 3	$20/80 = 25\%$	Interr. longer: 13	$7/80 = 8.7\%$
terr. equal: 80	Uninterr. " : 23	Unint. longer	Uninterr. " : 20	Unint. longer
420-420	Equal : 54		Equal : 47	
Uninterr.	Interr. longer: 4	$31/80 = 38.7\%$	Interr. longer: 5	$29/80 = 36.2\%$
42° longer: 80	Uninterr. " : 35	Unint. longer	Uninterr. " : 34	Unint. longer
462-420	Equal : 41		Equal : 41	
Uninterr.	Interr. longer: 0	$50/80 = 62.5\%$	Interr. longer: 4	$48/80 = 60\%$
84° longer: 80	Uninterr. " : 50	Unint. longer	Uninterr. " : 52	Unint. longer
504-420	Equal : 30		Equal : 24	

In the first place we are struck by the fact that with the shorter interruption the numbers are less regular and in the second place by the fact that with the shorter interruption there is more inclination to estimate the duration of the whole event

as being shorter. The latter is very remarkable; the interruption gives an apparent shortening in the duration, but a longer interruption seems to have less influence than a shorter one. From this we can directly infer that for a maximum of apparent shortening there must exist an optimum of interruption. Starting from this optimum the estimation of the duration of the whole increases both in lengthening and in shortening of the interruption, i.e. in case of the interruption becoming longer it is especially the stimuli and perceptions existing during the interruption which are used in judging the duration, whereas in case of the interruption becoming shorter it is especially the two filled-up parts of the exposition which are used. In the vicinity of the above-mentioned optimum now the filled-up parts, now the so-called vacant interval will have paramount influence so that here the judgment will also have the most irregular results.

When two stimuli p_1 and p_2 are given simultaneously it is not absolutely necessary that the perceptions belonging to them (g_1 and g_2) should also come about simultaneously or should reach their maximum at the same moment. So the time elapsing between the giving of the objective stimulus and the subjective perception, the so-called perception-time, is not always equally long for every stimulus. An example of unequal length of the perception-time, dependent on the intensity of the stimulus, is found in the well-known phenomenon of Pulfrich. A shorter or longer perception-time may depend on a quicker or slower course of the physiological responses, but also on a conceivable, though never measurable difference in time between a physiological process and its psychical correlation.

Every interval of which we want to estimate the duration is objectively limited by two stimuli, which we may call p_1 and p_2 , and subjectively by two perceptions, which we may call g_1 and g_2 . Now if the perception-time between p_1 and g_1 and between p_2 and g_2 should *ever* be measurable or mutually different, this might influence the time-estimation of the whole interval situated between p_1 and p_2 . Besides: though physical beginning and end of two intervals are equally distant in time, it is not yet certain that the series of physiological processes succeeding them and finally forming the correlation of the perceptions "beginning" and "end", should also lie equally distant in time. Especially the physiological responses roused

by the physical final stimulus will enact themselves with and without interruption of the interval on a differently prepared physiological ground and may therefore succeed the physical stimulus with unequal rapidity. We thought it would be possible to get an impression of this by causing the interrupted and the uninterrupted exposition to begin or end simultaneously or almost simultaneously. This examination was performed as follows: The size of the squares and their mutual distance were the same as in the preceding experiment. The interrupted object again continued for 420 σ , with an interruption of 140 σ or 350 σ . The uninterrupted object continued for 336 σ , 420 σ , or 504 σ . Owing to this we could cause: 1. both expositions to begin at the same time and to end at the same time; 2. only the beginning or only the end to be different; 3. both beginning and end to be either sooner or later. The observer had to express his opinion on beginning and end separately. In this examination, besides the objective difference between beginning and end, 3 factors may exert their influence; 1. the being projected more to the left or more to the right; 2. the being interrupted or not; 3. the duration of the interruption. The results were als follows:

Objectively	Subjectively
Left beginning sooner : 80	Left beginning sooner : 87
Right " " : 80	Right " " : 65
Equal : 120	Equal : 128
Left ending " : 80	Left ending " : 39
Right " " : 80	Right " " : 75
Equal : 120	Equal : 166

On the whole, therefore, the left object seems to begin somewhat sooner and to end somewhat later, to be perceived longer, therefore. It is very remarkable indeed that in successive projection it is just exactly the duration of the right object which is estimated as being somewhat longer. In this examination, however, we have to do with simultaneous projection; the images of the left object will fall more on the right retinal half and be perceived with the right cerebral hemisphere, while those of the right object are depicted more on the left retinal half and are perceived with the left cerebral hemisphere. Probably the difference is to be ascribed to this. Now if we

pay attention to the difference between interrupted and un-interrupted object, we find the following:

Objectively		Subjectively
Interr. beginning sooner	: 80	Interr. beginning sooner : 68
Uninterr. " "	: 80	Uninterr. " " : 84
Beginning at the same time	: 120	Beginning at the same time : 128
Interrupted ending sooner	: 80	Interrupted ending sooner : 28
Uninterrupted " "	: 80	Uninterrupted " " : 86
Ending at the same time	: 120	Ending at the same time : 166

A more detailed arrangement is shown in Table VI.

Whereas the uninterrupted object may seem to begin somewhat sooner it is very striking that it seems to end sooner. So the perception-time for the closing stimulus in uninterrupted exposition is shorter than in interrupted exposition. In simultaneous exposition the uninterrupted object is therefore seen for a somewhat shorter time than the interrupted object. Consequently the estimation of the interrupted object as being shorter in successive exposition cannot be ascribed to a difference in perception-time for the initial or the final stimulus. We can also exclude the idea that the difference in estimation in successive exposition should be founded on a different course of the retinal processes or on another peripheral cause.

Both with the short and with the long interruption we see that the number of cases in which the uninterrupted object seems to end sooner, is about 3 times as large as the number of cases in which the interrupted object seems to end sooner; only the number of cases in which a simultaneous ending was seen was larger with the long interruption, which means that the judgment was then more difficult.

As the result of the first experiment-series we think we may therefore ascertain:

1. that under some circumstances the interruption of a continuous light-stimulus may give an apparent shortening of the total event;
2. that for a maximal apparent shortening there must exist an optimal duration of the interruption;
3. that the apparent shortening by interruption of the stimulus cannot have its cause in the retina nor can be a conse-

Table VI

With an interruption of 140σ		With an interruption of 350σ		
Objectively	Subjectively	Certainty	Subjectively	Certainty
Interrupted Beginn. 84σ sooner 40	Interr. beginn. sooner: 30	24/60 = 60 % Interr. beginn. sooner	Interr. beginn. sooner: 29	25/40 = 62.5 % Interr. beginn. sooner
	Unint. " : 6		Unint. " : 4	
	Beg. at the same time: 4		Beg. at the same time: 7	
Uninterrupted Beginn. 84σ sooner 40	Interr. beginn. sooner: 5	21/40 = 52.5 % Unint. beginn. sooner	Interr. beginn. sooner: 1	34/40 = 85 % Unint. beginn. sooner
	Unint. " : 26		Unint. " : 35	
	Beg. at the same time: 9		Beg. at the same time: 4	
Beginn. same time 60	Interr. beginn. sooner: 2	6/60 = 10 % Unint. beginn. sooner	Interr. beginn. sooner: 1	4/60 = 6.7 % Unint. beginn. sooner
	Unint. " : 8		Unint. " : 5	
	Beg. at the same time: 50		Beg. at the same time: 54	
Interrupted ending 84σ sooner 40	Interr. ending sooner: 9	6/40 = 15 % Interr. ending sooner	Interr. ending sooner: 6	Same time
	Unint. " : 3		Unint. " : 6	
	End. at the same time: 28		End. at the same time: 28	
Uninterrupted ending 84σ sooner 40	Interr. ending sooner: 2	29/40 = 72.5 % Unint. ending sooner	Interr. ending sooner: 1	14/40 = 35 % Unint. ending sooner
	Unint. " : 31		Unint. " : 15	
	End. at the same time: 7		End. at the same time: 24	
Ending at the same time 60	Interr. ending sooner: 6	14/60 = 23.3 % Unint. ending sooner	Interr. ending sooner: 4	7/60 = 11.7 % Unint. ending sooner
	Unint. " : 20		Unint. " : 11	
	End. at the same time: 34		End. at the same time: 45	

quence of a shorter perception-time for the stimulus closing the interval.

Second experiment-series.

The results of the first experiment-series have strengthened our opinion that the time-estimation of an interval is founded on the judgment of the link or separation of the limiting stimuli or perhaps more accurately of the limiting perceptions. This renders it highly probable that the influence of an interruption will change in proportion as the objective duration of the total interval is greater or smaller. The duration of the continuously visible object in the preceding experiment-series was: 336 σ , 378 σ , 420 σ , 482 σ and 504 σ , so always below the 600 σ , which, according to the literature we may count among the so-called short periods of time. In this second experiment-series the duration of the continuously visible object amounted to: 1800 σ , 1620 σ , 1440 σ , 1260 σ and 1080 σ . The duration of the interruption object amounted to 1800 σ , with an interruption of 1500 σ , so that the limiting light-stimuli each lasted 150 σ . With this we have therefore come to the so-called long periods of time. The break between the two expositions amounted to 900 σ . The underestimation of the interrupted perception appeared to have considerably increased in these long periods of time, so that a continuous exposition was always estimated as being longer than the interrupted exposition.

We can also now in considering the results make a difference between left and right, first and last exposition, interrupted and uninterrupted exposition.

The difference between left and right gave the following result:

Objectively	Subjectively
Left longer : 80	Left longer : 59
Right " : 80	Right " : 43
Equal : 40	Equal : 98

In contradistinction to the first experiment-series the duration of the left object is now estimated as being somewhat longer. We would not contend that this has anything to do with the

longer duration of the exposition, as the lamps in the instrumentarium had meanwhile been replaced by others.

The difference between the object projected first and that projected last was as follows:

Objectively	Subjectively
First longer : 80	First longer : 40
Last " : 80	Last " : 62
Equal : 40	Equal : 98

Just as in the preceding experiment-series there seems here also to be a tendency to estimate the last object as being longer. We should bear in mind, though, that in this experiment-series "objectively longer" also implies that the object was interrupted which somewhat decreases the value of the conclusion. In the detailed Table VII we have, therefore, only shown how the proportions in the three groups are, according as the former and the latter object differ in duration.

Table VII

Objectively	Subjectively	Certainty
First longer : 80	First longer : 3 Last " : 39 Equal : 38	$36/80 = 45\%$ Last longer
First and last : 40 equal	First longer : 14 Last " : 20 Equal : 6	$6/40 = 15\%$ Last longer
Last longer : 80	First longer : 23 Last " : 3 Equal : 54	$20/80 = 25\%$ First longer

The group in which the first and last interval are equal in duration and which in both cases contains as many interrupted as uninterrupted expositions clearly shows that here, too, there exists a difference in estimation of the first and the last exposition. For the rest we see that the objectively longer exposition is generally subjectively estimated as being shorter. This is of course caused by the objectively longer object being also the interrupted one, so that we may infer from this table that the interruption has greater influence than the order and

that the underestimation of the interrupted object is greater, if it is projected first.

Most important just now is however the difference between interrupted and uninterrupted exposition. This gave the following results:

Objectively		Subjectively	
Interrupted	longer : 160	Interrupted	longer : 6
Uninterr.	" : 0	Uninterr.	" : 96
Equal	: 40	Equal	: 98

From this the very great underestimation of the interrupted object in these longer periods of time becomes apparent. A more detailed arrangement is given in Table VIII.

Table VIII

Objectively	Subjectively	Certainty
Interr. 720 σ longer : 40 1800—1080; 1080—1800	Interr. longer : 5 Unint. " : 2 Equal : 33	$3/40 = 7.5\%$ Interr. longer
Interr. 540 σ longer : 40 1800—1260; 1260—1800	Interr. longer : 0 Unint. " : 7 Equal : 33	$7/40 = 17.5\%$ Uninterr. longer
Interr. 360 σ longer : 40 1800—1440; 1440—1800	Interr. longer : 1 Unint. " : 23 Equal : 16	$22/40 = 55\%$ Uninterr. longer
Interr. 180 σ longer : 40 1800—1620; 1620—1800	Interr. longer : 0 Unint. " : 30 Equal : 10	$30/40 = 75\%$ Uninterr. longer
Interr. and unint. equal : 40 1800—1800	Interr. longer : 0 Unint. " : 34 Equal : 6	$34/40 = 85\%$ Uninterr. longer

From this table it becomes apparent that we must shorten the uninterrupted interval almost from 1800 σ to 1134 σ , i.e. 666 σ , to make it apparently equal to the interrupted interval. So the interruption gives an apparent shortening of 37%.

Not only absolutely, but also relatively the apparent shortening is much stronger here than with the exposition of shorter

duration in the first experiment-series. In trying to find an explanation of the stronger underestimation of the interrupted interval, we shall have to bear in mind that this being interrupted entails two changes. In the first place a *change* in the perception and in the second place the insertion of a *vacant interval*. Owing to the interruption in this second experiment-series we obtained, as it were, a vacant interval drawing but little attention, limited by two strong light-stimuli which definitely claimed attention. This interrupted interval had to be compared with a filled-up interval continuously drawing the attention to it because of a strong light-stimulus. It is obvious that the apparent shortening will be all the stronger as the limiting light stimuli have a greater share in the subjective judgment or that the apparent lengthening will be all the greater in proportion as the contents of the interval claim more attention (i.e. in proportion as the event during interruption plays a part in the judgment). The latter will certainly also be furthered if the expositions last longer.

Third experiment-series.

This investigation is as it were the negative of the preceding one. The two squares were continuously visible. One of the squares was made invisible for a short time and that during 1440 σ , 1620 σ , 1800 σ , 1980 σ , and 2160 σ . The other square became invisible for 150 σ , then visible for 1500 σ , and again invisible for 150 σ . Consequently we have, as it were, to compare two so-called vacant intervals one of which is filled up with the being visible of the square for 1500 σ . In contradistinction to the second experiment-series the limiting stimuli will perhaps require less attention here in case of the interrupted exposition, whereas during the interruption of the vacant interval the square then present will on the contrary require great attention. We might expect, therefore, that the apparent shortening of the interrupted interval in this series will be much slighter.

Here, too, we shall successively trace the difference between left and right image, between the image projected first and that projected last and between interrupted and uninterrupted interval.

The difference between left and right projection gave the following results:

Objectively	Subjectively
Left longer : 80	Left longer : 68
Right " : 80	Right " : 55
Equal : 40	Equal : 77

Just as in the second experiment-series, the interval projected on the left was estimated as being somewhat longer than the one projected on the right.

The difference between the interval projected first and that projected last was as follows:

Objectively	Subjectively
First longer : 80	First longer : 25
Last " : 80	Last " : 98
Equal : 40	Equal : 77

Just as in the two preceding experiment-series the first interval is here, too, estimated as being shorter than the last.

A more detailed arrangement is to be found in Table IX.

Table IX

Objectively	Subjectively	Certainty
First 360° longer : 40 1800—1440; 2160—1800	First longer : 12 Last " : 5 Equal : 23	7/40 = 17.5 % First longer
First 180° longer : 40 1800—1620; 1980—1800	First longer : 6 Last " : 15 Equal : 49	9/40 = 22.5 % Last longer
First and last equal : 40 1800—1800	First longer : 6 Last " : 23 Equal : 11	17/40 = 42.5 % Last longer
Last 180° longer : 40 1620—1800; 1800—1980	First longer : 1 Last " : 24 Equal : 15	23/40 = 57.5 % Last longer
Last 360° longer : 40 1440—1800; 1800—2160	First longer : 0 Last " : 31 Equal : 9	31/40 = 77.5 % Last longer

From this table we get the impression if the first object was exposed 281° longer, the periods of time would be estimated

as being about equal. The difference is absolutely much greater than in the first experiment-series (35 σ), but also relatively the difference is somewhat greater. In the first experiment-series we found equal estimation with a break of 210 σ , if the first object was exposed 437.5 σ and the second object 402.5 σ ; now we find equal estimation with a break of 900 σ , if the first object is exposed 1940.5 σ and the second object 1659.5 σ ; so this is in the first experiment-series a shortening of the first object with regard to the second of 8 % and in the third experiment-series of 14.5 %. The underestimation of the duration of the exposition of the first interval or the overestimation of the duration of the exposition of the last interval is therefore stronger with expositions of longer duration than with those of shorter duration.

The difference between interrupted and uninterrupted exposition gave the following results:

Objectively	Subjectively
Interrupted longer : 80	Interrupted longer : 29
Uninterr. " : 80	Uninterr. " : 94
Equal : 40	Equal : 77

A more detailed arrangement of this is shown in Table X.

Table X

Objectively	Subjectively	Certainty
Interrupted 360 σ longer : 40 1800—1440; 1440—1800	Interrupted longer : 14 Uninterr. " : 3 Equal : 23	11/40 = 27.5 % Interr. longer
Interrupted 1800 σ longer : 40 1800—1620; 1620—1800	Interrupted longer : 5 Uninterr. " : 14 Equal : 21	9/40 = 22.5 % Uninterr. longer
Interr. and uninterr. equal : 40 1800—1800	Interrupted longer : 6 Uninterr. " : 23 Equal : 11	17/40 = 42.5 % Uninterr. longer
Uninterr. 180 σ longer : 40 1980—1800; 1800—1980	Interrupted longer : 2 Uninterr. " : 25 Equal : 13	23/40 = 57.5 % Uninterr. longer
Uninterr. 360 σ longer : 40 2160—1800; 1800—2160	Interrupted longer : 2 Uninterr. " : 29 Equal : 9	27/40 = 67.5 % Uninterr. longer

Just as in the first experiment-series we have added a Table XI (A) of those cases in which the interrupted interval was exposed first and a Table XII (B) of those cases in which the interrupted interval was exposed last.

Table XI (A)

Objectively	Subjectively	Certainty
Interrupted 360° longer : 20 1800—1440	Interrupted longer : 2 Uninterr. " : 3 Equal : 15	1/20 = 5 % Uninterr. longer
Interrupted 180° longer : 20 1800—1620	Interrupted longer : 0 Uninterr. " : 13 Equal : 7	13/20 = 65 % Uninterr. longer
Interr. and uninterr. equal : 20 1800—1800	Interrupted longer : 0 Uninterr. " : 17 Equal : 3	17/20 = 85 % Uninterr. longer
Uninterr. 180° longer : 20 1800—1980	Interrupted longer : 0 Uninterr. " : 19 Equal : 1	19/20 = 95 % Uninterr. longer
Uninterr. 360° longer : 20 1800—2160	Interrupted longer : 0 Uninterr. " : 19 Equal : 1	19/20 = 95 % Uninterr. longer

Table XII (B)

Objectively	Subjectively	Certainty
Interrupted 360° longer : 20 1440—1800	Interrupted longer : 12 Uninterr. " : 0 Equal : 8	12/20 = 60 % Interr. longer
Interrupted 180° longer : 20 1620—1800	Interrupted longer : 5 Uninterr. " : 1 Equal : 14	4/20 = 20 % Interr. longer
Interr. and unint. equal : 20 1800—1800	Interrupted longer : 6 Uninterr. " : 6 Equal : 8	Equal
Uninterr. 180° longer : 20 1980—1800	Interrupted longer : 2 Uninterr. " : 6 Equal : 12	4/20 = 20 % Uninterr. longer
Uninterr. 360° longer : 20 2160—1800	Interrupted longer : 2 Uninterr. " : 10 Equal : 8	8/20 = 40 % Uninterr. longer

It is clear that also now the interrupted interval is again subjectively seen as being shorter or the uninterrupted interval subjectively as being longer. Both the order and the interruption are therefore of unmistakable influence. From Table X it appears that we must shorten the uninterrupted interval almost 261 σ , in order to estimate it as being of equal length as the interrupted interval. This is indeed a great difference with the results of the second experiment-series, in which we had to shorten the uninterrupted interval 666 σ , in order to make it equal to the interrupted interval. In the second experiment-series, however, the apparent shortening was still increased by the interruption, because of a vacant interval being inserted; in the third experiment-series, however, the apparent shortening was decreased by the interruption, because of a filled up interval having been inserted.

In case the strengthening in the second experiment-series and the weakening in the third completely counter-balance each other, an amount of $\frac{666 + 261}{2} = 463 \sigma$, might be assumed for the shortening, i.e. only for the account of the interruption. The interrupted interval of 1800 σ would then be estimated as being equal to an uninterrupted interval of 1337 σ , which means a shortening of about 26 %. From this it becomes apparent, therefore, that the shortening caused by interruption is stronger than the shortening on first exposition (14.5 %). This does not alter the fact, however, that there is a striking resemblance between Table IX and Table X, nor does it alter the results shown us in Table XII (B). The uninterrupted first exposition and the interrupted second exposition are estimated as being perfectly equal. We could also ascertain something of the kind in the first experiment-series (cf. p. 22).

Fourth experiment-series.

In discussing the preceding experiment-series we have already remarked that the apparent shortening caused by the interruption of a vacant interval is counteracted by the insertion of a part filled up with contents. In the interrupted interval of the preceding series we had successively to judge together 150 σ invisibility, 1500 σ visibility and again 150 σ invisibility of the square. It seemed highly probable to us that this judgment of

the total duration of time should be altered (become smaller) if the period of the visibility were chosen smaller and that of the invisibility correspondingly longer. We have, therefore, made further investigations as to the importance of the *duration* of the interruption in the estimated intervals, just as we did in the first experiment-series (p. 24). Therefore the invisibility was now only interrupted for 600 σ , so that successively we had 600 σ invisibility, 600 σ visibility and 600 σ invisibility of the square. It soon became apparent that under these circumstances the underestimation with regard to a continuous invisibility for 1800 σ was much greater, so that for the uninterrupted duration of invisibility we took: 1080 σ , 1260 σ , 1440 σ , 1620 σ and 1800 σ .

So we have, as it were, to compare two so-called vacant intervals, one of which is filled up with the being visible for 600 σ of a luminous square. Now also we could compare left and right projection with each other, which gave the following results:

Objectively	Subjectively
Left longer : 80	Left longer : 67
Right " : 80	Right " : 34
Equal : 40	Equal : 99

Just as in the second and third experiment-series, with longer duration of exposition, therefore, we see that the interval projected to the left is overestimated or that the one projected to the right is underestimated.

The difference between the first- and last-exposed interval gave the following results:

Objectively	Subjectively
First longer : 80	First longer : 38
Last " : 80	Last " : 63
Equal : 40	Equal : 99

"Objectively longer" just as in the second experiment-series means to say that the exposition was interrupted. In the detailed Table XIII, therefore, we only showed, here too, how the proportions in the three groups are according as the first and the last interval differ objectively in duration.

Table XIII

Objectively	Subjectively	Certainty
First longer : 80	First longer : 12 Last " : 17 Equal : 51	$5/80 = 6\frac{1}{4} \%$ Last longer
First and last equal : 40	First longer : 9 Last " : 17 Equal : 14	$8/40 = 20 \%$ Last longer
Last longer : 80	First longer : 17 Last " : 29 Equal : 34	$12/80 = 15 \%$ Last longer

This table shows the remarkable phenomenon that the objective difference between "first longer" and "last longer" subjectively scarcely finds expression. The explanation of this phenomenon should be looked for in the fact that with "first longer" an apparent shortening of the first interval manifests itself, both because of being interrupted and because of being projected first, whereas with objectively "last longer" the shortening of the first projected interval is for the greater part done away with because of the interruption of the second interval. With "first and last equal" the interrupted object was as many times projected first as last, so that in this case the influence of being projected first or last finds its purest expression.

Most important to us at the moment, though, is the difference between the interrupted and the uninterrupted exposition. This gave the following results:

Objectively	Subjectively
Interrupted longer : 160	Interrupted longer : 42
Uninterr. " : 0	Uninterr. " : 59
Equal : 40	Equal : 99

A more detailed arrangement is given in Table XIV.

From this Table becomes apparent the strong underestimation of the interrupted interval. We may infer from it that when

Table XIV

Objectively	Subjectively	Certainty
Interrupted 720 σ longer : 40 1800—1080; 1080—1800	Interrupted longer : 18 Uninterr. " : 1 Equal : 21	17/40 = 42.5 % Interr. longer
Interrupted 540 σ longer : 40 1800—1260; 1260—1800	Interrupted longer : 12 Uninterr. " : 6 Equal : 22	6/40 = 15 % Interr. longer
Interrupted 360 σ longer : 40 1800—1440; 1440—1800	Interrupted longer : 6 Uninterr. " : 8 Equal : 26	2/40 = 5 % Uninterr. longer
Interrupted 180 σ longer : 40 1800—1620; 1620—1800	Interrupted longer : 5 Uninterr. " : 19 Equal : 16	14/40 = 35 % Uninterr. longer
Interrupted and uninterr. equal : 40 1800—1800	Interrupted longer : 1 Uninterr. " : 25 Equal : 14	24/40 = 60 % Uninterr. longer

the uninterrupted exposition lasts 405 σ shorter, both expositions are estimated as being of equal length, i.e. when the interrupted exposition lasts 1800 σ and the uninterrupted exposition 1395 σ . Consequently the apparent shortening because of interruption amounts to 22.5 %. The underestimation of the interrupted exposition is therefore greater here than in the preceding experiment-series, in which the shortening owing to interruption amounted to 14.5 %. This does not imply, however, that the underestimation would go on increasing in proportion as the filled-up interruption is of shorter duration. This cannot be assumed; in case the duration of the interruption approaches zero, the underestimation becomes slighter again. So it must be possible to find a value for the duration of the interruption, in which the underestimation is maximal. Starting from this optimum the underestimation will decrease both in case of the interruption becoming longer and of it becoming shorter. The result of this experiment-series is therefore in complete agreement with that which was ascertained in our first experiment-series regarding the significance of the duration of the interruption (p. 24). From the fact stated at the time (p. 25)

we inferred that there must exist an optimum of interruption for the apparent shortening; that in case of the interruption becoming longer, it is especially the stimuli and perceptions existing during the interruption which are made use of in judging the duration, while in case of the interruption becoming shorter it is especially the two limiting expositions which are made use of.

The figures of our second experiment-series (p. 31) also led us to the same conclusion which we worded in this way that the apparent shortening will be all the stronger in proportion as the limiting stimuli require more attention, resp. the filled-up parts have a greater share in the subjective judgment, or that the apparent lengthening will be all the greater in proportion as the contents of the interval require more attention; i.e. in proportion as the event during interruption plays a part in the judgment.

That which was remarked with reference to the results in our first and second experiment-series can also be applied here on interpretation of the figures obtained in our fourth experiment-series and can serve as explanation. One may also try to interpret the last obtained results (fourth experiment-series) psychologically. At first we were adjusted to the judgment of the duration of our perceptions during the vacant interval. Owing to the square becoming visible the attention is diverted from the perceptions mentioned; because of this there arises an apparent shortening of the vacant interval, which is all the stronger in proportion as the square is longer present. But this apparent shortening is soon compensated for by longer duration of the interruption, as the square present now also begins to draw our attention and we become conscious of its duration, too. The stronger the stimulus during interruption will be, the sooner the compensation will come about and finally even make one expect an over-compensation, as the duration of an interval is estimated as being longer in proportion as the perceptions during the interval are stronger. The being stronger of the perceptions is not only dependent on the physical stimuli, but also on our psychical adjustment. This became very clear to us in the last experiment-series, where we had the impression that two kind of adjustment are possible. Paying too much attention to the interrupting square the estimation of duration was quite

different from that with paying more attention to the vacant intervals.

It is a matter of course that on the whole the luminous square requires more attention than a vacant interval. About this the next experiment-series will instruct us further.

Fifth experiment-series.

Several times already the difference in judgment of the duration of a so-called vacant interval and of a filled-up interval was pointed out. This fifth experiment-series is exclusively devoted to an investigation as to this difference, without the attention being distracted by any interruption therefore. The vacant interval is mostly given by a limitation with two stimuli of short duration (cf. e.g. second experiment-series). It is very well possible though that these limiting stimuli owing to their sudden appearance and disappearance draw the attention too much and consequently shorten the apparent duration of the so-called vacant interval. We have therefore compared the duration of the presence of a luminous square with the duration of the absence of a luminous square (which was therefore present during the rest of the time). The duration of the presence of the one luminous square was 1800 σ . The duration of the absence of the other square amounted to: 1440 σ , 1620 σ , 1800 σ , 1980 σ and 2160 σ . The break between the two intervals was just as in the 2nd, 3rd and 4th experiment-series 900 σ . The first and the last square alternately stood to the left and to the right.

So we can once more differentiate between left and right, first and last and filled-up and vacant interval.

The difference between right and left gave the following results:

Objectively	Subjectively
Left longer : 80	Left longer : 44
Right " : 80	Right " : 50
Equal : 40	Equal : 106

In contradistinction to the preceding series there is a slight inclination here to estimate the interval projected to the right as being longer. The difference is excessively slight though. The

difference between the interval projected first and that projected last gave the following results:

Objectively	Subjectively
First longer : 80	First longer : 15
Last " : 80	Last " : 79
Equal : 40	Equal : 106

Table XV shows a more detailed arrangement.

Table XV

Objectively	Subjectively	Certainty
First 360 σ longer : 40 1800—1440; 2160—1800	First longer : 12 Last " : 6 Equal : 22	6/40 = 15 % First longer
First 180 σ longer : 40 1800—1620; 1980—1800	First longer : 3 Last " : 12 Equal : 25	9/40 = 22.5 % Last longer
First and last equal : 40 1800—1800	First longer : 0 Last " : 12 Equal : 28	12/40 = 30 % Last longer
Last 180 σ longer : 40 1620—1800; 1800—1980	First longer : 0 Last " : 22 Equal : 18	22/40 = 55 % Last longer
Last 360 σ longer : 40 1440—1800; 1800—2160	First longer : 0 Last " : 27 Equal : 13	27/40 = 67.5 % Last longer

It is clear that also now the first interval is again estimated as being shorter than the last interval. From the Table with the regularly progressing numbers it is evident that the first interval must be projected 288 σ longer in order to seem equal in duration of time to the second; that is to say when the first interval lasts 1944 σ and the second interval 1656 σ , which means that the first interval is estimated as being 14.8 % shortened with respect to the second.

In the third experiment-series we found with the same duration of exposition a difference of 281 σ or a shortening of

14.5 %. This good agreement speaks for the reliability of the results.

Finally there is the difference in estimation between the vacant and the filled-up interval, the real end in view of this investigation. The results were as followed:

Objectively	Subjectively
Filled-up interval longer : 80	Filled-up interval longer : 73
Vacant " " : 80	Vacant " " : 21
Equal : 40	Equal : 106

In Table XVI underneath follows a more detailed arrangement.

Table XVI

Objectively	Subjectively	Certainty
Filled-up 360° longer : 40 1800—1440; 1440—1800	Filled-up interv. longer : 27 Vacant " " : 0 Equal : 13	$27/40 = 67.5\%$ Filled-up i. longer
Filled-up 180° longer : 40 1800—1620; 1620—1800	Filled-up interv. longer : 18 Vacant " " : 1 Equal : 21	$17/40 = 42.5\%$ Filled-up i. longer
Filled-up and vacant equal : 40 1800—1800	Filled-up interv. longer : 11 Vacant " " : 1 Equal : 28	$10/40 = 25\%$ Filled-up i. longer
Vacant 180° longer : 40 1980—1800; 1800—1980	Filled-up interv. longer : 11 Vacant " " : 7 Equal : 22	$4/40 = 10\%$ Filled-up i. longer
Vacant 360° longer : 40 2160—1800; 1800—2160	Filled-up interv. longer : 6 Vacant " " : 12 Equal : 22	$6/40 = 15\%$ Vacant i. longer

So the filled-up interval is undoubtedly estimated as being longer than the vacant one. At the same time we want to make out how the proportions are if the factors „first or last” and „vacant or filled-up” strengthen or weaken each other. We get in this way Table XVII (A) in which the vacant interval was exposed the first, and Table XVII (B) in which the vacant interval was exposed the last.

Table XVII (A)

Objectively	Subjectively	Certainty
Filled up i. 360° longer : 20 1440—1800	Filled-up i. longer : 15 Vacant " " : 0 Equal : 5	15/20 = 75 % Filled-up i. longer
Filled-up i. 180° longer : 20 1620—1800	Filled-up i. longer : 15 Vacant " " : 0 Equal : 5	15/20 = 75 % Filled-up i. longer
Filled-up and vacant i. equal : 20 1800—1800	Filled-up i. longer : 11 Vacant " " : 0 Equal : 9	11/20 = 55 % Filled-up i. longer
Vacant interval 180° longer : 20 1980—1800	Filled-up i. longer : 11 Vacant " " : 0 Equal : 9	11/20 = 55 % Filled-up i. longer
Vacant interval 360° longer : 20 2160—1800	Filled-up i. longer : 6 Vacant " " : 0 Equal : 14	6/20 = 30 % Filled-up i. longer

Table XVIII (B)

Objectively	Subjectively	Certainty
Filled-up interv. 360° longer : 20 1800—1440	Filled-up i. longer : 12 Vacant " " : 0 Equal : 8	12/20 = 60 % Filled-up i. longer
Filled-up interv. 180° longer : 20 1800—1620	Filled-up i. longer : 3 Vacant " " : 1 Equal : 16	2/20 = 10 % Filled-up i. longer
Filled-up and vacant interv. equal : 20 1800—1800	Filled-up i. longer : 0 Vacant " " : 1 Equal : 19	1/20 = 5 % Vacant i. longer
Vacant interv. 180° longer : 20 1800—1980	Filled-up i. longer : 0 Vacant " " : 7 Equal : 13	7/20 = 35 % Vacant i. longer
Vacant interv. 360° longer : 20 1800—2160	Filled-up i. longer : 0 Vacant " " : 12 Equal : 8	12/20 = 60 % Vacant i. longer

From Table XVI it is evident that if the vacant interval is exposed 252 σ longer, for 2052 σ therefore, it is estimated as being equal to the filled-up interval which is exposed for 1800 σ . So the shortening of the vacant interval with respect to the filled-up one amounts to 12.3 %.

In the second experiment-series a filled-up part of 1500 σ was on interruption replaced by a vacant one. Should this have given a shortening of 12.3 % the interrupted interval in the second experiment-series would have been estimated as being equal to a filled-up interval, which was 184 σ shorter. In reality it had to be shortened 666 σ . We can say, therefore, that the interruption without more or the influence of the limiting stimuli strengthened by this required a shortening of 482 σ .

Remarkable is the fact which is chiefly apparent from Table XVIII (B) that the difference in estimation between first and second interval and the difference in estimation between vacant and filled-up interval are almost equally great. The equally great influence of the two factors may be accidental, but it is also possible that generally the first interval is always judged in the way of a vacant one or the second interval always in the way of a filled-up one, at least with intervals of longer duration. An extensive investigation as to this point is being made. There is the more occasion to do so, as in the first as well as in the third experiment-series we met with analogous phenomena. In our first experiment-series it became apparent that the two factors "sooner or later" and "interrupted or uninterrupted" balanced each other and we speculated as to whether perhaps the apparent shortening caused by projecting first and by interruption might have an analogous psychophysiological cause. We also met with a similar phenomenon in our third experiment-series (p. 36) where an uninterrupted first exposition and an interrupted second exposition were estimated as being perfectly equal.

We have already remarked that for the committing to memory of the duration of time of the first interval probably more attention is given to the limiting stimuli; this may happen with a vacant interval and also more or less with an interrupted interval. The duration of the second interval will probably only be judged independently in case of very short intervals in order to be compared with the first interval. With intervals of longer

duration we assimilate as it were the beginning of the second interval with the beginning of the remembered image of the first interval; we reproduce the first interval; should the end of the second interval come before the reproduction of the first interval has vanished, we estimate the second interval as being shorter; should this end come later, we estimate the second interval as being longer. Therefore our attention is drawn more to the contents instead of to the limiting stimuli in the second interval.

D. *Conclusions and speculations.*

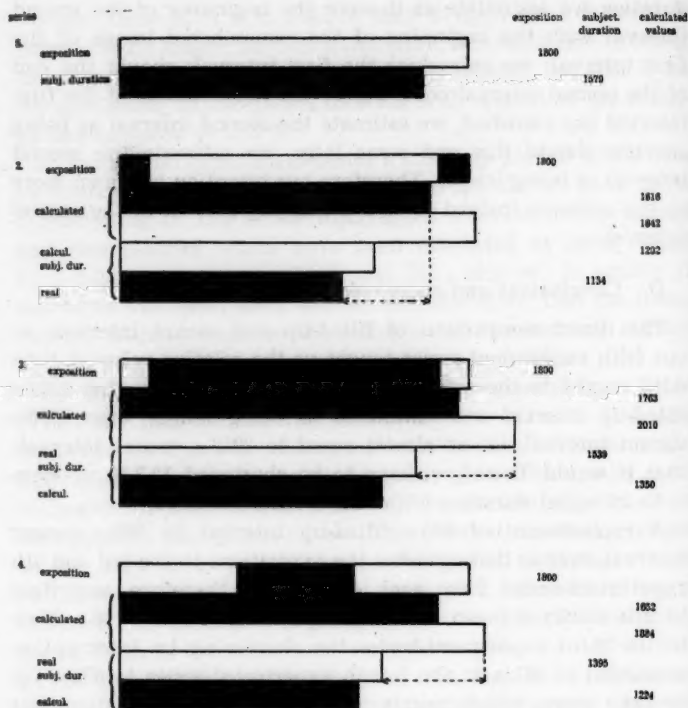
The direct comparison of filled-up and vacant intervals in our fifth experiment-series taught us the relative value of both with regard to the estimation of duration; we saw that 1800 σ filled-up interval was estimated as being longer than 1800 σ vacant interval, i.e. as almost equal to 2052 σ vacant interval; that it would, therefore, have to be shortened 12.3 % to seem to be of equal duration with 1800 σ vacant interval.

A replacement of 900 σ filled-up interval by 900 σ vacant interval, such as distinguishes the expositions in the 3rd and 4th experiment-series from each other, will, therefore, according to this standard mean a shortening of $1026 - 900 = 126 \sigma$. Now in the third experiment-series the shortening by interruption amounted to 261 σ , in the fourth experiment-series to 405 σ , i.e. to 144 σ more, which nearly agrees with the expectation just derived from the fifth experiment-series.

Continuing this train of thought also for the other experiment-series, one may on replacement of a filled-up part of interval by a vacant part of interval take into account a shortening of 12.3 %, and may finally trace if anything remains and what this will amount to in case of shortening through the fact of interruption.

We have, therefore, chosen the apparent duration of a filled-up interval as our standard and set ourselves the task to express the vacant intervals in filled-up ones for the several experiment-series and expositions of 1800 σ and to picture this in the annexed table.

In the fifth experiment-series the exposition of 1800 σ vacant interval was estimated as $1800 - 12.3 \% = 1579 \sigma$ filled-up interval.



In the second series the exposition of 1800 σ interval (of which 1500 σ interrupted interval) would, according to this standard have to be estimated as:

$$\begin{aligned}
 300 + (87.7 \% 1500) &= 1616 \sigma \text{ filled-up interval; or as:} \\
 1500 + 342 &= 1842 \sigma \text{ vacant interval.}
 \end{aligned}$$

We ascertained, however, a duration equal to 1134 σ filled-up interval, so that the difference of $1616 - 1134 = 482 \sigma$ as apparent shortening would be due to the fact of the interruption.

In the third experiment-series the exposition of 1800 σ (vacant, of which 1500 σ interrupted by light), according to the standard derived from experiment-series V. would have to be estimated as:

$1500 + 263 = 1763 \sigma$ filled-up interval, resp. as

$300 + 1710 = 2010 \sigma$ vacant interval.

We ascertained a duration equal to 1539σ vacant interval, so that the difference $2010 - 1539 = 471 \sigma$ vacant interval or 413σ filled-up interval as apparent shortening would be due to the fact of the interruption.

In the fourth experiment-series the duration of the exposition of 1800σ vacant interval (interrupted by 600σ filled-up one) would according to the same standard have to be estimated as:

$600 + 1052 = 1652 \sigma$ filled-up interval

resp. $1200 + 684 = 1884 \sigma$ vacant interval.

The subject (Z) ascertained, however, a duration equal to 1395σ vacant interval, so that the difference $1884 - 1395 = 489 \sigma$ vacant interval or 429σ filled-up interval as apparent shortening would be due to the fact of the interruption.

The *interruption* gave therefore a shortening which may be looked upon as equal to the apparent duration of a filled-up interval of 482σ , 413σ and 429σ . The great agreement between these numbers raises the surmise that with the subject Z. the interruption of a duration of exposition of 1800σ is equal to an apparent shortening of nearly one fourth of this time namely on an average 441σ or 24.5% , with which we must still leave undecided whether to these 441σ , required by the interruption, an absolute significance (441σ) or a relative one (24.5%) is due. It seems far from certain to us whether we must also expect this shortening, if the interruption takes up almost the whole interval or is of excessively short duration.

In the latter case when the interruption becomes slighter and slighter, we have as limit an interval without interruption, so without shortening. One may only ask oneself whether this disappearance of the shortening takes place rather suddenly or more gradually, or if perhaps the shortening does not decrease before the interruption becomes smaller than 441σ .

A continuous increase of the interruption in a filled-up interval does not end in a vacant interval, no more than a continuous increase of the interruption in a vacant interval ends in a filled-up interval. In both cases the interval completely dis-

appears. What happens when this limit is approached, can only be ascertained in an investigation specially directed to this fact.

From this consideration of the disappearance of the whole interval it follows, however, that the investigation as to the influence of the interruption on the estimation of time has a far greater significance than an investigation as to a certain way of filling up an interval. In this respect it becomes clear to us that each interval to be judged is really the judgment of the duration of an interruption of an existing state of things. We can for instance apply this train of thought to the circumstances existing in our fifth experiment-series, where both the whole vacant and the filled-up interval can be seen as interruptions of an originally vacant (dark) environment or of one filled with light.

Should an exposition objectively last such a short time that the estimation of duration approaches 0, the same objective time in a continuous environment would give an estimation of duration going back to 441σ ; and this causes the question to arise if these 441σ must be looked upon as a limit, measure for the subjective duration of the roused minimal processes (intervals) which would then answer the character of an interruption. Should the minimum of subjective duration be due to this objective duration, which experienced as interruption allows a subjective shortening of 441σ , the smallest duration to be experienced subjectively might be put at 441σ . This conclusion is only permissible, however, if to these 441σ an absolute value would be due, which is not proved and perhaps not very probable, but which is worth while being examined.

The results obtained and the conclusions drawn from them have opened up a new series of questions and new perspectives to us. We are perfectly aware, though, that in these somewhat superficial conclusions not all factors have been sufficiently valued.

It goes, for instance, without saying and is implied in the word itself, that every interval is an interruption of a more or less continuous state of things; but it is premature to assume that to this interruption the same value would be due as to the interruption within an interval to be judged.

In the first case the limiting perceptions will as a rule scarcely have our attention; in the second case the perceptions limiting

the interruption on the contrary require a great deal of our attention. We may explain the meaning of this in view of our results.

In the second experiment-series we have to judge a vacant interval of 1500σ + two limiting filled-up intervals, each of 150σ . These joint happenings are estimated as being equal to a filled-up interval of 1134σ , which in accordance with the fifth experiment-series is equal to a vacant interval of 1404σ . The additions with filled-up intervals at the beginning and at the end have shortened the total estimation with $1500 - 1404 = 96 \sigma$ (vacant interval) therefore. This seems to point to the fact that the filled-up parts directly drew our attention and that thus the attention was distracted from the perceptions on interruption.

The same is evident from a comparison of the third with the fifth experiment-series. In the third experiment-series, namely, a filled-up interval of 1500σ , together with two limiting vacant intervals of 150σ , are estimated as being equal to a vacant interval of 1539σ or are calculated in accordance with the fifth experiment-series as being equal to a filled-up interval of 1350σ . So we see in the third experiment-series that the joining of the two vacant parts to the filled-up part of 1500σ causes the whole interval to be estimated as being shorter instead of longer. This, too, can only be accounted for by our attention being directly drawn to the vacant part and only gradually coming about for the filled-up part. At the end of the discussions on the fourth experiment-series we already remarked that the results of this experiment-series could be arbitrarily influenced either by fixing our attention more on the vacant parts or more on the filled-up part of the interval. Without special instructions it appears that one gives most attention to those impressions which are presented first for judgment, i.e. in the 3rd and 4th experiment-series to the vacant parts and in the 2nd experiment-series to the filled-up parts.

From the preceding it may be directly inferred that the interruption which is present in every interval as a matter of course and without which an interval cannot exist, gives a slighter apparent shortening than an interruption within an interval to be judged.

One is even confronted with the question, in view of the

great influence of the limiting perceptions, whether the difference between the estimation of duration of a vacant and a filled-up interval perhaps rests more on the nature of the limiting perceptions than on the contents of the interval itself, or rather on the proportion of the intensity with which we become aware of the limiting stimuli and of the contents of the interval.

In this light we once more want to view the results of the fifth experiment-series. Here we found that a vacant interval of 1800σ is estimated as being equal to a filled-up interval of 1579σ , while on the other hand we may infer from this that the light presented to the person staying in the dark more strongly draws the attention and is experienced as being of longer duration than the darkness interrupting the condition of light.

An ample territory to be investigated evidently opens up to us once more in this connection, in which especially the significance of the limiting stimuli or perceptions should be accurately examined.

Let us end up by recapitulating the chief results of the five experiment-series; these were:

1. An interrupted exposition, at least with a duration of $420-1800\sigma$ is estimated as being shorter than an uninterrupted exposition. This is a confirmation of former results of experiments, which were partly also found already by Van der Waals and Roelofs.
2. The apparent shortening of an interrupted exposition cannot have its cause in a shorter perception-time nor in retinal processes; it can on the whole not rest on a later beginning or earlier ending of the physiological responses roused in the sensorial paths.
3. With a longer total duration of exposition the apparent shortening by interruption is both absolutely and relatively stronger than with a shorter total duration of exposition.
4. In order to obtain a maximal apparent shortening of the total exposition there exists an optimum of the duration of the interruption.

5. A vacant interval is estimated as being shorter than a regularly filled-up interval. With a vacant interval of 1800 σ this apparent shortening of a vacant interval amounts to about 12.3 %.

6. If one takes this apparently shorter duration of a vacant interval into account, the influence of the interruption without more within ample limits appears to be independent of the duration of the interruption. With an interval of 1800 σ an interruption gives an apparent shortening of 441 σ or about 24.5 %.

7. Under the proportions given in the experiment-series the first exposition was by the subject Z. regularly estimated as being shorter than the last.

8. With a duration of exposition of 1800 σ and a break of 900 σ the apparent shortening of the first exposition amounted to 14.6 %. With a duration of exposition of 420 σ and a break of 210 σ the apparent shortening of the first exposition amounted to about 8 %.

9. The apparent shortening because of being projected first is therefore considerably slighter than the apparent shortening brought about by an interruption. The apparent shortening because of being projected first is almost equal to the apparent shortening of a vacant interval with regard to a filled-up one.

The physiological happenings of which the phenomena found are the expression must enact themselves where sensorily received and cortically integrated experiences intervene and rouse responses in the course of the internal vital processes and their central regulation; our observations give us no occasion to go more deeply into this fact for the present.

We will not omit, however, to point out that these experiments seem to afford a renewed proof as to of how great significance the contents of the happenings on which the duration is experienced, are for estimation of the subjective duration. (Cf. v. d. Waals and Roelofs; part. 2, p. 52).

Neither shall we try to give a physiological interpretation here of the phenomena described.

For this purpose we should see them in broader connection, which as yet we wish to reserve to ourselves.

To be continued

ÜBER DAS ERLEBNIS DES LEBENSALTERS

von

GUSTAV KAFKA

Vom Erlebnis des Lebensalters zu reden, klingt zwar nicht schön, lässt sich aber wegen der Doppeldeutigkeit des Ausdruckes „Alter“ nicht vermeiden. Denn während in den alten Sprachen eine Verwechslung des Greisenalters (*γηρας*, senium) mit dem Lebensalter (*ηλικία*, aetas) nicht möglich ist, steht in den modernen Sprachen kein Ausdruck zur Verfügung, um das Lebensalter vom Greisenalter zu unterscheiden, ja es ist sogar meistens das Greisenalter gemeint, wenn vom Alter schlechthin die Rede ist. Kann daher die Frage, wie der Mensch zu verschiedenen Zeiten sein Lebensalter erlebt, im Deutschen die schwerfällige Stilisierung nicht vermeiden, so hat sie doch offenbar ein zentrales Problem des menschlichen Lebens zum Gegenstande. Das geht schon aus der Redensart hervor „Jeder ist so alt, wie er sich fühlt“, in der jedoch die Relativierung des Alters einen etwas veränderten Sinn erhält; denn sie kommt dadurch zustande, dass der Mensch seine eigene Eindrucks-, Leistungs- und Widerstandsfähigkeit vergleicht, die ihm für andere Altersstufen charakteristisch erscheint, und erst auf Grund dieses Vergleiches sein Lebensalter mittelbar einer bestimmten Altersstufe zuordnet. Dagegen soll in Folgenden jenes Erlebnis des Lebensalters untersucht werden, das nicht erst einen mittelbaren Vergleich, sondern einem „absoluten Eindruck“ entspringt, dessen Bedeutung die Psychologie in immer steigendem Masse zu würdigen gelernt hat. Wie man also etwa bei der Beurteilung des absoluten Eindrucks von Gewichten die logische Einsicht zurückstellen muss, dass kein Körper schlechthin, sondern nur im Vergleich zu anderen Körpern „schwer“ erscheint, so kann man der Eigenart des Lebensalter-Erlebnisses nicht gerecht werden, solange man sich nicht von der Voraussetzung freimacht, dass man die Zahl der zurückgelegten Jahre berechnen müsste, um sein Lebensalter erleben zu können, sondern man darf sich der Möglichkeit nicht verschliessen, dass das erlebte Lebensalter eine Gesamtqualität des

„Lebensgefühles“ ist, dessen Entwicklung allerdings an bestimmte Lebenszeiten geknüpft ist, das sich aber dann unabhängig von der kalendarischen Zahl der Jahre für eine bestimmte Zeit konstant erhält. Auch diese Möglichkeit wird bereits durch eine Alltagsbeobachtung bestätigt, nämlich durch den weit verbreiteten Typus der Leute, „die nicht vergessen können, dass sie jung gewesen sind“, also der Lebegreise und der alten Koketten. Dem Psychologen kann es natürlich nicht genügen, diese Typen nach dem allgemeinen Brauch lediglich als komische oder anstössige Figuren zu registrieren, sondern er wird nach den seelischen Ursachen der Erscheinung fragen und damit auf das allgemeine Problem stossen, wieso es kommt, dass man zwar verstandesmässig genau feststellen kann, wie alt man ist, sich aber trotzdem gefühlsmässig einer ganz anderen Altersklasse als dem eigenen Geburtsjahrgang zugehörig erleben kann.

Diese Formulierung des Problems lässt zugleich den bedeutsamen Umstand hervortreten, dass sich das Erlebnis des Lebensalters überhaupt nicht so sehr auf ein zeitliches als vielmehr auf ein soziales Erlebnis begründet, nämlich auf das Erlebnis der Gleichaltrigkeit oder Homelike. Ja es ergibt sich ein neues Paradox daraus, dass der „absolute“ Eindruck des eigenen Lebensalters weithin durch den Eindruck einer Relation, u.z. einer sozialen Relation der eigenen zu gleich- oder verschiedenaltigen Personen bestimmt wird.

Eine wissenschaftlich befriedigende Untersuchung dieser Erscheinung würde natürlich eine systematische Befragung zahlreicher Personen verschiedenen Alters, verschiedenen Geschlechts und verschiedener sozialer Stellung erfordern, zu der ich, offen gestanden, die Zeit nicht mehr erübrigen kann. Ich hoffe daher, dass sie von jüngeren Kräften durchgeführt werden wird, da ich selber mich ausser auf Gelegenheitsbeobachtungen im wesentlichen auf eigene Erfahrungen beschränken musste. Immerhin mögen die folgenden Ausführungen den Anstoss zur Klärung eines bisher vernachlässigten Problems.

Zu jenen Gelegenheitsbeobachtungen gehört es, dass schon vorschulpflichtige Kinder sich zu Gruppen zusammenschliessen, die von den „ganz kleinen“ ebenso entschieden abrücken wie von den nur um wenige Jahre älteren, sobald sie ihnen in irgend einer Weise überlegen vorkommen. Die ausschlaggebende Über-

legenheit ist natürlich nicht eine Überlegenheit der individuellen Leistungen schlechthin, denn innerhalb einer jeden Gruppe werden die Leistungsfähigeren von den weniger Leistungsfähigen mehr oder weniger neidlos als „Führer“ anerkannt, sondern eine Überlegenheit, die aus dem Bewusstsein entspringt, dass ihre Leistungen der ganzen eigenen Altersgruppe unerreichbar wären. Auf die Eigenart dieses Erlebnisses kann nicht nachdrücklich genug hingewiesen werden, sowohl darauf, dass es den Charakter eines „absoluten Eindrucks“ besitzt, also nicht erst durch einen bewussten Vergleich der eigenen Leistungen mit den Leistungen anderer Personen entsteht, als auch darauf, dass in diesem absoluten Eindruck genau so wie in den absoluten Eindrücken auf dem Gebiete der Sinneswahrnehmung eine Einbeziehung und Verschmelzung vergangener Erfahrungen ihren Niederschlag findet, die sich kaum jemals zur vollen Klarheit des Bewusstseins bringen lässt. So viel scheint jedenfalls festzustehen, dass in jene Gesamtqualität des Lebensgefühles das Erlebnis des eigenen und die Abschätzung der fremden Eindrucks-, Leistungs- und Widerstandsfähigkeit eingeht, dass sie sich also auf Macht- und Ohnmacht-, Mehr- und Minderwertigkeits-, Geltungs- und Unzulänglichkeitsgefühle begründet. Gerade deshalb aber, weil alle diese Gefühle irgendwie in einem Erlebnis des Selbst- oder Fremdwertes wurzeln, bildet ihre Gesamtheit eine zuverlässige Grundlage des Verhaltens und damit einer scharfen Gruppentrennung.

Besonders deutlich wird diese Gruppenbildung bei der Schuljugend, innerhalb derer bereits die einjährigen Klassenunterschiede unübersteigliche Grenzen aufzurichten pflegen, die sich erst wieder im Laufe der praktischen oder theoretischen Berufsausbildung verwischen. Ja gegenüber der künstlichen Gruppenbildung der Schule tritt erst jetzt wieder eine natürliche Gruppenbildung auf, die sich aber in einem viel höheren Masse von dem kalendarischen Alter unabhängig zeigt als die natürliche Gruppenbildung des frühkindlichen Alters. Zur Erweiterung der als gleichaltrig erlebten Gruppe trägt einerseits der Umstand bei, dass sich die Gleichheit der Leistungsfähigkeit nunmehr über einen viel grösseren Altersbereich erstreckt als während der Früh- und Schulkindheit, und dass sich überhaupt erst jetzt das Erlebnis einer echten und ernsthaften, weil lebenswichtigen Leistung und damit eines Selbstwertes entwickelt, andererseits

die kritische Wendung von der Pubertät zur Lebensreife, die dann einsetzt, wenn die Abnabelung von der Gemeinschaft des Elternhauses zur Verselbstständigung innerhalb eines eigenen sozialen Umkreises, insbesondere innerhalb des Verhältnisses zum anderen Geschlecht stattfindet. Denn das Bewusstsein der erotischen Leistungsfähigkeit — in einem sehr handgreiflichen und vorwiegend körperlichen Sinn bei dem jungen Mann, bei dem jungen Mädchen meist in einem viel sublimierteren seelischen Sinne — erweitert den Umkreis der als gleichaltrig erscheinenden Gruppen auf alle Personen des anderen Geschlechtes, die dem absoluten Eindruck nach als mögliche Geschlechtspartner erlebt werden.

Zugleich beginnt sich die Gruppe nach dem Merkmal des erlebten Selbstwertes und -Unwertes von anderen Gruppen abzusondern: Für den Lehrling sind es vornehmlich die Gesellen und die Meister, für den Studenten seine akademischen Lehrer, mit einem Worte: für den Untergebenen die Vorgesetzten, die sich als Gruppe deutlich von der Gruppe der als gleichaltrig erlebten Personen abheben, auch wenn in Wirklichkeit nur ein kleiner, ja vielleicht sogar überhaupt kein kalendarischer Altersunterschied besteht. Mit dieser äusseren Grenzziehung geht aber Hand in Hand eine Verfestigung des inneren Kernes der Persönlichkeit als des Trägers einer selbständigen Verantwortung, die ebensowohl aus dem Antritt einer beruflichen Stellung wie aus der Gründung eines eigenen Hausstandes erwachsen kann und — zumal in früheren Zeiten — im allgemeinen gleichzeitig aus beiden Gründen erwuchs.

Nun aber zeigt sich die eigentümliche Unabhängigkeit des Alterserlebnisses vom kalendarischen Alter gerade darin, dass dieses Erlebnis einer um den Kern des erlebten Eigenalters zentrierten Altersgruppe mit ihren Unterschieden gegenüber den Gruppen eines als verschieden erlebten Lebensalters durch lange Zeit konstant bleibt, was sich natürlich erst feststellen lässt, wenn zwischen dem kalendarischen und dem erlebten Lebensalter bereits eine beträchtlichere Verschiebung eingetreten ist. Dann merkt etwa der 40-Jährige, dass er — um den unteren Grenzfall eines Streuungsbereiches herauszugreifen, der sich bis in den Beginn der 30er Jahre erstrecken kann, — seit seinem 25. Jahre nicht älter geworden ist, d.h. dass ihm bei der Anknüpfung neuer Bekanntschaften 25-jährige Personen dem

absoluten Eindruck nach durchaus noch als gleichaltrig, Personen seiner eigenen Altersklasse, ja unter Umständen sogar noch jüngere, umso viel älter und überlegener erscheinen, wie sie ihm als 25-Jährigem erschienen wären. Seinen alten Bekannten gegenüber bleibt dagegen auch die alte Einschätzung bestehen: die subjektiv Gleichaltrigen erscheinen ihm noch ebenso jung wie damals, sie bleiben, grob gesagt, junge Dächse, deren objektive Leistungen und Verdienste ebenso wenig ernst genommen werden wie die eigenen, und das für die Aussenstehenden oft so sonderbare und anstössige „Kälbern“ alter Jugendfreunde beruht nicht etwa auf der künstlichen Wiederauffrischung begrabener Erinnerungen, sondern auf dem Erlebnis einer unmittelbar gegenwärtigen gemeinsamen Jugend. Umgekehrt erhält sich aber auch der Überlegenheitseindruck, den etwa der 30-jährige Assistent auf den 25-jährigen Studenten gemacht hatte, selbst wenn dieser es mit 40 Jahren zum Ordinarius gebracht hat, während sein früherer Lehrer trotz seiner 45 Jahre über den Extraordinarius nicht hinausgekommen ist: mag jenem die Reflexion noch so eindeutig die eigene Überlegenheit zum Bewusstsein bringen, — dem absoluten Eindruck nach bleibt der frühere „Vorgesetzte“ für ihn doch noch immer in gewisser Hinsicht eine Respektperson. Genau so verhält es sich auch um die Beziehungen zum anderen Geschlecht: Frauen, die mit dem 25-Jährigen jung gewesen sind, insbesondere die eigene Frau, bleiben für ihn — ausser wenn er sie sehr lange nicht gesehen hat und sie in der Zwischenzeit äusserlich auffallend gealtert sind — selbst als angehende Matronen noch immer jung, und umgekehrt empfindet er sich als 40-Jähriger im Kreise junger Mädchen und Frauen, unter Umständen sogar seiner Studentinnen, durchaus nicht fehl am Ort, sondern ganz „in seinem Element“, weil ihm der objektive Altersunterschied subjektiv gar nicht zum Bewusstsein kommt. Dasselbe gilt natürlich auch für „die Frau von vierzig Jahren“, und es ist eigentümlich, dass sich in der reichhaltigen Literatur, welche das Liebesleben jener Frauen zu schildern unternommen hat, nirgends ein Hinweis auf die grundlegende psychologische Tatsache jenes Gleichaltrigkeitserlebnisses findet.

Andererseits gilt für die Unterschiede des Lebensalters, die der 25—50-Jährige erlebt, ein Doppeltes. Einmal zeichnen sich zwei Typen der „Alten“ ab, die in engen zeitlichen Beziehungen

zu der Eltern- und Grosselterngeneration stehen. Die Eltern erscheinen dem 25—50-Jährigen, wenigstens solange er sich der Fünzigergrenze selber noch nicht allzusehr angenähert hat, das ungefähre Alter von 50 Jahren beizuhalten, das sie hatten, als er selber etwa 25 Jahre alt war: die „Alten“ werden also ihrerseits ebensowenig älter wie es die Jungen unter den alten Bekannten geworden sind. Zum anderen aber werden alle infolge ihrer sozialen Überlegenheit als älter erlebten Personen für den unmittelbaren Eindruck altersmässig der Elterngeneration angeglichen, so dass auf diesem Wege die Altersüberschätzung einen überraschend hohen Grad erreichen kann (wodurch sich nebenbei manche „Übertragung“ der Psychoanalyse erklären würde). Neben diesem elterlichen besteht aber gleichzeitig der grosselterliche Alterstypus. Was nämlich über die Fünzigergrenze hinausliegt, verschwimmt dem 25—50-Jährigen in einem unbestimmten Hintergrund des Greisenalters, innerhalb dessen sich keine wesentlichen Unterschiede mehr feststellen lassen, und weil es jenseits dieser Grenze keine unmittelbar erlebten Unterschiede mehr gibt, erscheint der 60-Jährige und der 80-Jährige der gleichen Stufe eines in dem Sinn „unendlichen“ Alters angehörig, dass es „grösser ist als jede beliebige Grösse“.

Es besteht also für das unmittelbare Erleben dem absoluten Eindruck nach eine eigentümliche Unterschätzung des eigenen Lebensalters, die sich bei neuen und alten Bekantschaften in analoger, aber nicht ganz übereinstimmender Weise auswirkt. Denn bei neuen Bekantschaften bringt das abstrakte Wissen um ihre Zugehörigkeit zu einem jüngeren Jahrgang keineswegs den absoluten Eindruck der eigenen Altersüberlegenheit hervor, der zu erwarten wäre, während das abstrakte Wissen um ihre Zugehörigkeit zur gleichen Altersgruppe einen absoluten Eindruck ihrer Altersüberlegenheit nicht zu unterdrücken vermag, auch wenn er sich sachlich in keiner Weise begründen lässt; bei alten Bekantschaften dagegen überträgt sich die Unterschätzung des eigenen Alters dem absoluten Eindruck nach auf die kalendarisch Gleichaltrigen, so dass ihre tatsächliche Überlegenheit über die jüngere Generation ebensowenig erlebt wird wie die eigene, während die seinerzeit als älter erlebten Jahrgänge die Überlegenheit behalten, die sie dem absoluten Eindruck nach für den 25-Jährigen besaßen, selbst

wenn seine eigenen Leistungen die ihrigen erreicht oder sogar übertroffen haben. Natürlich gilt das Gesagte nur unter der Voraussetzung, dass kein auffälliger Widerspruch zwischen der äusseren Erscheinung und dem kalendarischen Alter besteht, dass also die neuen Bekannten nicht wesentlich jünger oder älter aussehen und sich gebärden, als sie in Wirklichkeit sind, und dass sich die alten Bekannten nicht durch Sorgen oder Krankheiten bis zur Unkenntlichkeit verändert haben. Denn der absolute Eindruck des Lebensalters wird durch eine gewisse Typik der Erscheinung und des Gehabens bestimmt, deren Grenzen zwar verhältnismässig weit gezogen, dennoch nicht beliebig verschiebbar sind. Das ergibt sich schon daraus dass jenes Zugehörigkeitsgefühl zur Altersgruppe der 25-Jährigen im allgemeinen nicht während des ganzen Lebens bestehen bleibt, sondern etwa um das 50. Jahr einer anderen Einschätzung Platz macht.

Dabei scheinen die beiden Daten von 25 und 50 Jahren als Angelpunkte des Lebensaltererlebnisses keineswegs zufällig zu sein, sondern wie die Entwicklung zur Vollpersönlichkeit unter den heutigen Verhältnissen in der Zeit zwischen dem 25. und 30. Lebensjahr einzusetzen pflegt, — es wäre interessant, die allmähliche Verspätung dieser Entwicklung zu untersuchen, die innerhalb der Neuzeit seit den Tagen der Renaissance unter dem Einfluss der fortschreitenden Zivilisation stattgefunden und unter der Nachwirkung des nationalsozialistischen Systems und des zweiten Weltkrieges ihren bisherigen Höhepunkt erreicht hat, — so pflegen um das 50. Jahr bei jedem Menschen „klimakterische“ Erscheinungen aufzutreten, die keinen Zweifel an der Abnahme jenes psychologischen „Vigor“ aufkommen lassen, der ein Analogon zu dem körperlichen Vigor bildet, mit dem die Entwicklungslehre als dem massgebenden Faktor der biologischen Leistungs- und Widerstandsfähigkeit zu rechnen gelernt hat. Dieses Nachlassen des Vigor macht sich zwar zunächst auf körperlichem Gebiete geltend, zumal um jene Zeit eine besondere Anfälligkeit gegen Krankheiten aufzutreten pflegt, aber auch in seelischer Hinsicht ist namentlich die Eindrucks- und Widerstandsfähigkeit herabgesetzt, während die geistige Schaffenskraft noch voll erhalten oder sogar gesteigert sein kann. Alles in allem wird sich aber nicht nur die Frau in der Menopause, sondern auch der Mann von 50 Jahren bewusst,

„dass die Tage der Rosen vorbei sind“, und gewinnt dadurch eine von Grund auf veränderte Lebenseinstellung, die freilich nicht mit einem Schlag einzusetzen, sondern sich allmählich zu entwickeln pflegt, und von der natürlich das Lebensaltererlebnis in besonderem Mass betroffen wird. Diese Wirkung zeigt sich freilich den alten Bekannten gegenüber weniger deutlich als bei neuen Bekanntschaften. Denn die kalendarisch gleichaltrigen Bekannten aus früherer Zeit haben dadurch nichts an Würdigkeit gewonnen, dass auch sie jetzt für den unmittelbaren Eindruck zu „alten Krauterern“ geworden sind, wie Vieles und wie Grosses sie inzwischen geleistet haben mögen, und das Gleiche gilt für die kalendarisch Jüngeren, die früher dem absoluten Eindruck nach als Gleichaltrige erschienen waren, während die „Respektpersonen“ aus der früheren Zeit noch immer den Nimbus einer erlebten Überlegenheit behalten.

Anders verhält es sich jedoch mit den neuen Bekanntschaften, denn hier findet das Wissen um eine „junge Generation“, die irgendwie „mitzählt“, zum ersten Mal eine unmittelbare Erlebnisgrundlage, während sich der 40-Jährige noch unbedenklich zu der jungen Generation rechnete und eine Grenze erst gegenüber Kindern und Jugendlichen zog. Dagegen wiederholt sich auch bei dieser Einstellung die Unterschätzung des eigenen Lebensalters, die sich allerdings erst dann wieder deutlich zeigt, wenn zwischen kalendarischen und erlebtem Alter eine grössere Verschiebung eingetreten ist. Sie wirkt ganz in derselben Weise wie früher nämlich dahin, dass etwa dem 60-Jährigen 50-Jährige, unter Umständen sogar noch etwas jüngere Personen, die er neu kennen lernt, als durchaus gleichaltrig erscheinen, während ihm andere 60-Jährige wiederum den gleichen Eindruck der Überlegenheit erwecken wie etwa dem 40-Jährigen die kalendarisch Gleichaltrigen. Daraus ergibt sich das eigentümliche Paradox, dass sich der 60-Jährige befremdet fühlt, wenn er bei einem 50-Jährigen, den er neu kennen lernt und daher dem absoluten Eindruck nach in seine eigene Altersgruppe einteilt, Zeichen einer Ehrerbietung entdeckt, die ihm ganz unmotiviert erscheint, während er selber dem kalendarisch Gleichaltrigen dieselbe Ehrerbietung zu zollen bereit ist. Nur ist gegenüber der früheren Zeit insofern ein bedeutsamer Unterschied eingetreten, als die Aufspaltung der „Alten“ in eine elterliche und eine grosselterliche Altersgruppe naturgemäss geschwunden ist.

Statt dessen gibt es nur mehr eine einzige undifferenzierte Gesamtgruppe der „ganz Alten“, die etwa mit den 60-Jährigen unter den neuen Bekannten beginnt, aber ebenso die 80-Jährigen und die noch Älteren mitumfasst.

Naturgemäss wird sich der Kreis derer, denen sich der Alternde dem absoluten Eindruck nach unterlegen fühlt, immer mehr verengern, und daraus erklärt sich die Selbtherrlichkeit und Unduldsamkeit des Alters. Geht andererseits die gefühlsmässige Unterschätzung des eigenen Lebensalters zu weit, behält also der 50-Jährige gewissermassen einen blinden Fleck für die Grenze, die ihn von der jungen Generation scheidet, so entsteht die scheinbar so komische, in Wirklichkeit aber so tragische Figur des oder der „ewig Jugendlichen“. Ihre Tragik beruht schon darauf, dass jene Fehlschätzung gerade deshalb nicht durch den Verstand richtiggestellt werden kann, weil sie sich auf den absoluten Eindruck begründet, in noch viel höherem Masse aber darauf, dass jene ewig Jugendlichen ihrem Lebens-typus nach zu den Frühvollendeten gehören, denen das Schicksal die Gnade eines Todes in der Fülle der Zeit versagt hat. Denn es ist schon im Früheren darauf hingewiesen worden, dass die Vollreife der gesamt menschlichen Persönlichkeit (die nach dem Gesagten durchaus noch nicht die geistige Höchststufe einzuschliessen braucht) in die Zeit zwischen dem 25. und dem 50. Jahr zu fallen pflegt. Stützt sich das Selbstwertgefühl des 25-Jährigen in erster Linie auf die körperliche Leistungsfähigkeit, die seelische Empfänglichkeit und die erotische Anziehungskraft, während es sich auf dem Gebiet der sozialen Geltung nicht weit über das Bewusstsein eines glücklich gewonnenen Ausgangspunktes erheben kann, so ist es umgekehrt in vorwiegendem Masse der soziale und berufliche Erfolg, der den 50-Jährigen über das Schwinden der Hochspannung tröstet, die seine Gesamtpersönlichkeit in der Zeit ihrer Vollreife beherrschte, soweit er nicht überhaupt die Verlagerung des inneren Schwerpunktes in die geistige Sphäre vollzogen hat, — ja der Spätvollendete wird seine höchste Reife erst in der Weisheit des Alters erleben und offenbaren. Daraus folgt aber, dass der Unterschied zwischen Früh- und Spätvollendeten, soweit er sich sowohl auf ihre Leistungen wie auf ihr Verhalten begründen lässt, auch im Erlebnis des Lebensalters seinen Niederschlag finden wird, je nach der Form, welche die Lebenskurve an-

nimmt. Im allgemeinen wird nach dem Gesagten diese Kurve zwei Gipfelpunkte aufweisen, in denen ein bestimmtes kalendarisches Alter eine repräsentative Bedeutung für die Folgezeit erhält, und deren erster ungefähr um das 25., der zweite um das 50. Jahr anzusetzen ist. Indessen dürfte gerade diese Datierung den grössten individuellen Unterschieden unterliegen, ja es bestehen zwei Möglichkeiten des Überganges der zweigipfligen in eine eingipflige Kurve. Einmal kann die Gesamtpersönlichkeit infolge widriger innerer oder äusserer Umstände ihre Vollreife im Sinne eines Höhepunkts des Selbstwertgefühles erst so spät erreichen, dass der erste mit dem zweiten Gipfel so gut wie zusammenfällt, zum andern kann der „ewig Jugendliche“ so wenig bereit sein, den Übergang vom einen zum andern Gipfel zu vollziehen, dass ihm die Reife des Alters überhaupt versagt bleibt. Der Typenunterschied zwischen den Früh- und den Spätvollendeten oder, wie vielleicht jetzt ohne Gefahr eines Missverständnisses gesagt werden kann, zwischen denen, die nicht älter als 25 Jahre werden, und denen, die nie jünger als 50 Jahre gewesen sind, drückt sich auch physiognomisch aus, sofern es Gesichter gibt, die nicht nur ihren Reiz, sondern auch ihre Eigentümlichkeit mit zunehmenden Alter verlieren und zu rechten leeren Allerweltsphysiognomien werden, während andere, die in den Jahren der Frühreife ziemlich unbedeutend und „gewöhnlich“ aussahen, erst durch das Alter eine Prägung erhalten, die das Wesen ihres Trägers zu endgültigem Ausdruck bringt.

An diese Beobachtung liesse sich vielleicht — um mit Kant zu reden — eine „artige Betrachtung“ anknüpfen, die für die christliche Dogmatik nicht ganz bedeutungslos sein dürfte. Denn so unbestimmt auch die Vorstellung des „vergeistigten Leibes“ ist, in dem die Seligen auferstehen sollen, liegt doch die Annahme am nächsten, dass dieser Leib der Veränderung ebenso wenig wie der Verwesung unterworfen sein, sondern in alle Ewigkeit der gleiche bleiben wird. Dann muss er aber die verstorbene Person zu einer ganz bestimmten Zeit ihres irdischen Lebens darstellen, und damit erhebt sich die berechtigte Frage, in welcher der verschiedenen körperlichen Erscheinungsweisen seines irdischen Lebens der Selige wieder aufersteht. Die Frage, wie denn die Grossmutter in Himmel aussehen soll, um von den Kindern als ihre Mutter, von den Enkeln als ihre Ahne,

von ihrem Mann als seine Braut und Gattin wiedererkannt zu werden, hat daher einen guten Sinn, selbst wenn sie vom „Tollen Bomberg“ nur aufgeworfen wird, um das Dogma der Auferstehung ins Lächerliche zu ziehen. Die übliche Antwort der Dogmatik, der verklärte Leib werde von so überirdischer Schönheit sein, dass darüber alle irdischen Mängel verblassen, kann indessen nicht befriedigen, da es sich ja in erster Linie gar nicht um Wertunterschiede, sondern um tatsächliche Unterschiede handelt, sofern das Aussehen des Menschen zu verschiedenen Zeiten seines irdischen Lebens nun einmal ein verschiedenes ist, und der verklärte Leib das Bild der Person daher auch nur in einem bestimmten Zeitpunkt ihres irdischen Lebens wiedergeben kann. Nun lassen sich gewiss verschiedene Wege ahnen, auf denen sich jene Schwierigkeit überwinden liesse, aber vielleicht weisen die vorhergehenden Erörterungen auf die einfachste Lösung hin. Denn wenn sich das Wesen des Menschen zu verschiedenen Zeiten mit verschiedener Deutlichkeit in seiner Erscheinung ausprägt, so läge er nahe, dass die körperliche Erscheinung, in welcher das Wesen des Menschen während seines Lebens den angemessensten Ausdruck gefunden hat, auch diejenige sein möchte, in der er wiederersteht, und dass gerade dieses Hindurchleuchten des Wesens durch die äussere Erscheinung die Erkennbarkeit der Person für alle anderen Personen bewirkt.

Aber auch wer Bedenken trägt, sich auf dogmatische Spekulationen einzulassen, wird der Erfahrungstatsache Rechnung tragen müssen, dass jeder Mensch zu seinem eigenen Bild ein ganz eigentümliches Verhältnis besitzt. Dieses Verhältnis zeigt sich schon in der Anziehungskraft, die das eigene Spiegelbild ausübt und die sich durchaus nicht immer auf blosser Eitelkeit zurückführen lässt, es liegt auch der Furcht des Primitiven zugrunde, dass mit seinem Bild ein Zauber getrieben werden könnte. Aber wenn man beobachtet, welchen Wert die meisten Menschen darauf legen, bei allen möglichen Gelegenheiten abgebildet, insbesondere photographiert zu werden, und mit welchem feierlichen Ernst sie diese Prozedur über sich ergehen lassen, ja wenn man überdies durch Selbstbeobachtung die sonderbare Benommenheit feststellt, die einem im Augenblick des Modellstehens ganz ebenso wie bei der Betrachtung eigener Bilder überfällt und die wiederum nicht auf ein blosses Gefühl

des „Sich Genierens“ zurückgeht, sondern sozusagen als Hauch aus einer anderen Welt erlebt wird, so kommt man zu dem Ergebnis, dass auch hier eine Berührung der Zeit mit der Ewigkeit den Kern des Erlebnisses ausmacht. Das Bild erscheint deshalb so geheimnisvoll, weil es eine flüchtige Welle aus dem Strom des Lebens festhält und gerade damit dessen ewigen Fluss aufhebt, es ist ein Moment des ewigen Wechsels und doch jedem Wechsel entrückt. Dieses Geheimnis scheint aber den Menschen deshalb so tief aufzuwühlen, weil er sich im Unbewussten die Frage vorlegt, welches von seinen Bildern denn nun das „richtige“ ist, d.h. welches von ihnen sein wahres Wesen am reinsten ausdrückt. Eine solche Suche nach dem richtigen Bild der eigenen Persönlichkeit setzt aber ihrerseits voraus, dass es ein solches Bild gibt und dass es mit einer der vielen Erscheinungen zusammenfallen muss, welche die Person im Laufe ihres Lebens annimmt. Damit erhält jedoch die Annahme eine neue Stütze, dass es im Leben eines jeden Menschen eine Zeit gibt, in der sein Wesen am reinsten durch die Erscheinung hindurchleuchtet, und die zuvor gegebenen Hinweise auf das Erleben des Lebensalters hätten ihren Zweck erfüllt, wenn sie einen Anhaltspunkt zur Bestimmung jener Zeiten zu liefern vermöchten.

SUMMARY:

The evaluation of one's own age as well as of the age of other persons is not based upon a conscious comparison, but upon an "absolute impression". This impression becomes independent of the actual age as soon as the individual develops a personality standing out, in definite relations, against its social background. This usually happens at an age of about 25 from which term on the individual is prone to underestimate its own age, that is to say, to feel himself as not ageing beyond the limit of 25 years. Consequently, his old acquaintances will remain at what age-level they were at this time of his life, whereas the age of new acquaintances will generally be overtaxed. Thus e.g. to a quadragenarian other quadragenarians with whom he gets newly acquainted will appear much more advanced in years, while he will consider himself coetaneous with new acquaintances whose actual age is much lower than his own. Although the point of reference shifts with reaching an age of approximately 50, the propensity to underrate one's own age persists under practically the same symptoms, except for the fact that a new and definitely younger generation seems to have arisen.

The phenomenon described should account for a number of apparent social oddities and maladjustments.

LA PSYCHOLOGIE DU «MIEN» *)

par

LÉON LITWINSKI

1. *Le moi et le mien.*

Il y a un demi siècle environ, William James (9, p. 228) a énoncé, sans l'approfondir, qu' «au sens le plus large du mot, le moi enveloppe tout ce qu'un homme peut appeler sien».

Un quart de siècle plus tard, Charles Blondel (4, t. II, p. 531) approfondit cette idée, jetée au vent comme un grain, et conclut que les rapports entre le moi et le mien sont si étroits et si constants que la psychologie est dans l'impossibilité de les distinguer. Force lui est donc de «rattacher provisoirement le mien au moi».

Bien qu'un peu décevant, ce provisoire est de bon aloi. En s'abstenant de conclure, on réserve la faculté d'avancer par paliers. Science jeune, la psychologie progresse comme toutes les sciences de la périphérie au centre. Or, le problème du moi ou du mien est un problème central par excellence.

L'adjectif possessif *mien* exprime le rapport d'appartenance, un lien particulier entre le sujet et l'objet (chose animée ou non, matérielle ou spirituelle, individuelle ou collective). Cet adjectif peut avoir tantôt un sens subjectif, tantôt un sens objectif et même les deux sens dans une même phrase (6, p. 152).

Pour J. M. Baldwin (2), c'est le critérium du mode, qui constitue le dualisme du sujet et de l'objet. Il entend par le sujet le *Moi* du nominatif, le *je* qui pense et juge, et par objet le *moi* ou l'autre chose quelconque auxquels le *Moi* pense ou desquels il juge» (p. 490) ¹⁾.

*) Rapport présenté au XII-me Congrès International de Psychologie, Edimbourg, juillet 1948.

¹⁾ Remarquons que Titchner (19, p. 133) formule différemment sa pensée à cet égard. Pour lui, le concept de „Je” (I) n'est qu'un des ingrédients de l'idée du moi (self) qui apparaît comme un agrégat. „C'est le 'Je', dit-il, qui constitue le lien assemblant les idées variées relatives à la situation sociale ou professionnelle, à l'attitude scientifique ou religieuse, etc., contenues dans l'idée du moi (self)”.

Ici Baldwin s'accorde avec Mansel (16, p. 54) pour qui toute opération de la pensée est un jugement, au sens psychologique de ce terme; mais le jugement psychologique ne doit pas être confondu avec le jugement logique.

On distingue chez l'homme les fonctions de percevoir, de concevoir, d'évaluer, d'agir. On définit le moi comme chose soit perçue, soit conçue. Le moi est ainsi l'idée que l'on se fait de soi-même et de ses attaches qui le prolongent au dehors. L'extensibilité étant admise comme une tendance fondamentale du moi, l'identification devient une forme du processus d'extension et d'unification du moi. L'idée du moi implique en effet la cohérence interne et l'identité externe.

En définissant le moi comme étant la conscience de l'individu quant à son identité continue et de ses rapports avec le milieu, on insiste d'habitude davantage sur la première partie de cette définition. Or, comme il sera montré dans la suite, il y a intérêt d'insister également sur la seconde partie. Insister sur les miens, revient à mettre l'accent sur l'extensibilité du moi, sur l'aspect dynamique du moi dans la totalité de la personnalité.

C'est également concrétiser davantage les recherches concernant la vie du moi. En effet, si l'on définit la personnalité comme englobant la totalité des rapports externes et internes dont le moi est le centre, nos miens ou si l'on préfère nos biens matériels et autres, afin de parler plus concrètement, constituent une partie essentielle de cette personnalité.

Quant à l'*ego*, qui en principe s'oppose à l'*alter*, c'est à dire à l'autre, on le conçoit souvent comme synonyme du moi, comme l'idée que l'individu se fait de soi-même et ses attaches. On le conçoit aussi comme la portion du moi (Allport) comme une illusion grammaticale (Nietzsche), etc. Il y a aussi la tendance de réserver ce terme à la psychoanalyse.

2. Attitude exploratrice et attitude prospective.

Ce qui importe en psychologie du mien, ce n'est pas tant de savoir où se dissimule dans une phrase le sujet ou l'objet, mais quel est le caractère du rapport entre le moi et les miens, concevables soit comme un centre et sa constellation ou sa périphérie, soit comme deux pôles opposés. Plus précisément, il faut connaître le caractère de l'action du sujet, pris au sens restreint du moi, sur l'objet, considéré au sens large du terme,

c.à.d. se rapportant aussi bien à la chose matérielle qu'à l'être ou même à l'idée. Le but visé par cette action n'est pas toujours nécessairement celui d'établir un lien possessoire. On peut agir sans chercher à se lier. On n'explore pas toujours en vue de la possession durable et exclusive. On est curieux par nature sans avoir nécessairement un objet précis en vue. En principe, l'action peut s'appliquer à des fins multiples et variés.

C'est en conséquence d'une attitude prospective du moi que le lien possessoire est susceptible de s'établir entre l'objet et le sujet, qui s'équipe prospectivement. Psychologiquement, ce lien s'exprime dans le sentiment que nous avons désigné ailleurs sous le concept de l'attente dans la détente (14, 15, 16).

Si l'extension du moi offre, par le truchement de la propriété le sentiment exaltant de la sécurité et de la supériorité, le retrecissement du moi, par suite de privation ou de renoncement, nous laisse, par contre, le sentiment déprimant de la peur et d'infériorité. La propriété modifie la mentalité. Contrairement au possesseur, le propriétaire craint moins la visite du voleur.

C'est un des points faibles d'une étude publiée récemment par M. Sherif et H. Cantril (20), que ces deux psychologues américains, en parlant des engagements de l'ego, n'indiquent pas plus précisément le caractère de l'attitude que ces engagements expriment. Chose curieuse, ils trouvent vain (*meaningless*) de s'efforcer de classer les attitudes.

G. W. Allport, disent-ils, a résumé la variété de classification en attitudes comme suit: positive et négative, spécifique et générale, publique et privé, commune et individuelle. Du moment que les traits caractéristiques de n'importe quelle attitude, dans le cas de n'importe quel individu, doivent varier selon les situations et les circonstances dans lesquelles l'attitude s'est développée, ainsi que sa fonction individuelle, toutes les classifications d'attitude deviennent presque aussi nébuleuses que celles relatives à la situation des stimulants (y compris objets, personnes, groupes, valeurs et normes) ou des rapports avec les personnes ou les sociétés (*personal and societal relationships*). De simples classifications dichotomiques ne font que défigurer et fausser le problème (p. 24).

Il y a lieu, nous semble-t-il, de regretter d'abord que l'opinion de Sherif et Cantril, au sujet de l'intérêt des classifications dichotomiques, soit présentée d'une manière aussi extrême, et,

ensuite, que parmi les dichotomies citées d'après G. W. Allport ne figure pas celle de prospective et de rétrospective. On la trouve chez James Baldwin notamment et elle est d'un intérêt primordial.

Sherif et Cantril distinguent, à juste titre, une simple tension de l'attitude à proprement parler, donc un état éphémère, passager et sans lendemain, par opposition à un état stabilisé, chargé de représentation ou de préoccupation dans le cas d'engagement («ego-involvement»). Ils le font par le truchement de la conception d'«enduring readiness» (p. 21), c.à.d. de la promptitude durable. Cette conception ne semble pas exprimer d'une manière adéquate la nature de ce fait psychologique indéniable que Blondel, pour sa part, se contente de qualifier d'une sorte de «halo affectif». Il environne «les êtres qui nous touchent, les objets qui nous appartiennent» (p. 524). Certains voudraient peut être l'attacher à la capacité de l'homme d'animer les objets inertes par la force du moi qui s'incarne dans le mien au stade mythique de la mentalité humaine.

Il est clair que le sujet et son objet ne se regardent pas comme deux chiens de faïence car l'un des deux au moins est sensé être animé. On voudrait connaître plus précisément la nature, psychologique de cet *animus* qui lie le sujet à l'objet. Pour nous, il s'exprime dans le sentiment d'attente dans la détente, dans un lien d'appartenance.

Pour E. Kretschmer (12, p. 27), l'expérience interne immédiate se partage entre deux pôles: le moi et le monde extérieur. Tout ce qui est psychique, autrement dit toute expérience interne, est pour Kretschmer un produit de l'action réciproque qui s'exerce entre le moi et le monde extérieur, soit que le moi subisse l'influence du monde extérieur (processus de réception), soit au contraire, qu'il agisse sur le monde extérieur (processus d'extériorisation ou d'expression).

C'est par l'affectivité que nous apprécions la valeur, la portée qu'un processus psychique présente pour nous. «Elle comprend donc aussi bien les sentiments les plus simples, tels que plaisir et déplaisir, excitation et indifférence, que les mouvements psychiques plus complexes: amour, colère, angoisse, désir, convoitise, etc.» (p. 28).

Pour nous, le sentiment de la propriété s'y classe également. Quant à la distinction entre la tension et l'attitude (Sherif et

Cantril), nous la concevons simplement comme le passage du fait à la valeur, comme une simple tendance du sujet à un jugement d'appréciation. C'est la distance qui sépare le désiré du *désirable*. La chose désirée n'est pas nécessairement désirable. La chose visée par un kleptomane n'est pas précisément la chose choisie par le propriétaire. Dans le cas de l'irrésistible kleptomanie, on «vole pour voler, comme on aime pour aimer, sous le coup de fouet du désir» comme parle Zola (22) à propos de la comtesse de Boves.

Vouloir, c'est agir, avons-nous dit dans notre théorie du lien possessor (14, p. 439—40 et 445). On agit soit sous l'impulsion d'un besoin présent, soit en vue d'un besoin futur. Assouvir la faim qui nous tourmente est une expérience psychologiquement moins complexe que faire des provisions pour l'hiver, parce qu'elle n'est pas chargée de la préoccupation de l'avenir. Le besoin satisfait, l'état de conscience qui l'accompagnait est arrivé à sa fin, il s'est épuisé. Il en est autrement s'il s'agit d'un besoin anticipé. Pour se rendre maître de l'objet susceptible de le satisfaire, il fait passer par la tension de la tendance ayant en vue son acquisition. Avec cette dernière, cette tendance est consommée. Ce n'est pas tout. Un autre état de conscience se forme par rapport à l'objet acquis, qui n'est plus chargé du désir présent mais de l'intérêt par anticipation. Cet état de conscience est soutenu par l'idée ou la représentation que nous nous faisons de la signification de l'objet par rapport aux besoins anticipés, en nous basant sur l'expérience passée, grâce à notre capacité de prévoyance.

La possession ou la propriété est donc un état de conscience caractérisé par une attente dans la détente. L'attente indique la direction de notre esprit, et la détente la faiblesse relative de la tension psychologique, justifiée à la fois par le pouvoir effectif que nous exerçons sur l'objet, et la protection, sous forme du droit de propriété, que le milieu social accorde à ce pouvoir. L'intérêt est soutenu par la persuasion intime de l'utilité future de l'objet ainsi que par la persuasion d'ordre social que notre maîtrise est légitime, ce qui se traduit dans la conscience par le sentiment de sécurité qu'éprouve le propriétaire.

Certes, l'intérêt anticipatif que l'homme entretient relativement à l'objet n'a plus, comparé à l'état de conscience existant quand cet objet n'était que convoité, la flamme du désir de s'en

rendre maître, mais il a, par contre, l'apaisement, le calme de l'idée de son utilité dans l'ordre du bien, du vrai ou du beau. L'objet devient soudé pour ainsi dire à un réseau plus ou moins organisé et systématisé du mien, à titre plus ou moins permanent ou temporaire, selon la nature du besoin que l'objet doit satisfaire et la nature de l'objet lui-même. Cet objet rentre dans le réseau du mien par différentes voies d'accès ou modes d'acquisition, pour parler la langue des juristes.

A notre avis, la détention physique, la saisie, la mainmise de l'individu sur une chose, toutes ces manières différentes de caractériser le pouvoir effectif de l'individu sur l'objet marqué par son intérêt, ne donnent pas encore une idée adéquate du lien de possession, car le pouvoir en question n'exprime pas nécessairement que cette prise est effectuée en vue de l'avenir et non du présent. Le problème ne consiste pas à savoir pourquoi nous établissons un rapport entre nous et un objet quand le besoin est actuel, mais *pourquoi* nous le faisons même quand ce besoin ne l'est pas ou ne l'est plus, c'est-à-dire quand nous agissons par anticipation.

J'ai faim, j'entre au restaurant, je m'y fais servir un repas, je paye et je m'en vais. Il y avait tension. Il y a ensuite détente. Quant à l'objet ou au moyen qui a servi à amener cette détente, il a disparu avec la faim, complètement ou partiellement, peu importe. Il était intéressant pour autant que la faim persistait. Il n'y a pas de lien de possession à proprement parler entre l'hôte et le repas servi.

Je n'ai pas soif, je passe devant un magasin. J'achète une bouteille de bière. Je la mets dans une cave. J'ai soif, j'en bois la moitié, je mets le reste de côté. Il y a possession, accompagnée d'une attente dans la détente par rapport à l'objet conservé.

Au point de vue strictement juridique, on pourrait dire que dans les deux cas que nous venons d'évoquer, l'homme se rend propriétaire, aussi bien du repas qu'il consomme sur le champ que de la bouteille qu'il conserve pour plus tard, car la propriété, d'après la définition courante, équivaut au pouvoir de l'individu d'user d'une chose et d'en retirer toute l'utilité qu'elle est susceptible de procurer d'une manière exclusive et permanente. Au point de vue psychologique, cependant, un lien sans détente diffère foncièrement d'un lien détendu, parce que ce dernier, contrairement au premier, est chargé d'une pré-

occupation spéciale, d'un souci de l'avenir. Tous les deux peuvent naître dans des conditions analogues, mais ils vivent et meurent différemment. Dans le cas d'un rapport éphémère et passager, constitué en vue de la satisfaction d'un besoin présent, la tension de l'état de conscience, dirigée vers la mainmise sur le moyen, passe par tous les stades d'activation et meurt avec le désir satisfait. S'il s'agit d'acquisition de ce même moyen en vue de la possession, le rapport n'a pas épuisé sa carrière par la satisfaction du besoin présent. Il a un lendemain. Il est capable de continuer cette carrière et passe dans la conscience du propriétaire à l'état d'une attente dans la détente. Il s'agit évidemment du cas des objets qui sont limités dans la nature, au point de vue de leur disponibilité, des objets qui ne disparaissent pas avec le service rendu, mais qui peuvent rendre ce même service d'une manière continue ou renouvelée, car nos besoins eux-mêmes sont, d'habitude, rythmiques.

En résumé, psychologiquement parlant il y a lieu de distinguer nettement entre le simple état de conscience et la disposition et ensuite entre ces deux derniers et le sentiment. Méthodologiquement, il y a le fait, l'idée et le mot. Du fait qu'un objet irrite la curiosité de l'enfant, il n'y a pas lieu de conclure qu'il est désirable, qu'il est susceptible de créer une disposition et à la plus forte raison fonder un sentiment organisé.

3. *Ego, ses différentes conceptions et sa nature.*

Dans un article publié en 1943, Gordon W. Allport²⁾ passe en revue les principales conceptions de l'ego de la psychologie contemporaine (ego comme connaisseur, comme organisateur, comme observateur, comme chercheur d'une position et d'un rang, comme être socialisé, etc.)²⁾. Il en a trouvé huit au total.

Un point à relever: cette énumération ne comporte nullement l'ego comme maître, comme détenteur ou acquéreur, comme possesseur ou propriétaire. C'est une lacune à notre avis.

S'il est question d'idées, par exemple, comme objet de jugements de valeur, parler d'ego comme connaisseur ou émetteur d'idées est autre chose que parler d'ego comme possesseur d'une idée. Penser et retenir sa pensée en vue de l'avenir sont deux

²⁾ Ego as knower, as organizer, as observer, as status seeker, as socialized being.

choses différentes. Il en est ainsi, à plus forte raison, s'il est question d'objets matériels.

Il est vrai qu'Allport parle de ces derniers subsidiairement au paragraphe relatif à l'ego comme objet de connaissance.

«Nous pensons parfois, dit-il, d'un outil dont nous nous servons comme d'un composant de notre système d'ego étendu. Quelquefois nous considérons nos enfants, notre habitation ou nos ancêtres comme une parcelle intime de l'extension de nos moi. On reconnaît ainsi que les systèmes d'ego dont nous avons conscience sont réductibles ou extensibles de la manière la plus variable».

«Parfois», «quelquefois», dit Allport. Pourquoi ces limitations? Le mien qui est lié au moi est comme le Dieu des Chrétiens: il est présent partout et toujours. Il n'y a pas lieu, nous semble-t-il, de parler plus ou moins timidement de l'appartenance d'un outil, d'une maison, etc. comme d'un état accidentel, étant donné que cet état est d'ordre général, universel, d'une expérience quotidienne. C'est sans doute parce que l'appartenance se présente ici d'habitude à l'état relâché, qui est celui de la sécurité, que les théoriciens du moi n'en sont pas frappés. D'autre part, il est possible que l'éclipse des miens matériels tienne en l'occurrence à la théorie même de la nature de l'ego avancée par Allport. Pour ce dernier, l'ego n'est qu'une «portion» du moi, c.à.d. un simple secteur. Ainsi conçu, l'ego jouit d'une sorte de priorité sur d'autres tendances qui se départagent la vie du moi. Il vise aux couches ou aux niveaux supérieurs d'aspiration («level of aspiration»). Allport parle de l'ego, comme s'il parlait de l'enceinte d'une citadelle murée et non d'un vaste camp à peine retranché du moi. Cette soi-disant citadelle est défendue plus ou moins par l'autorité de psychologues tels que Koffka, Lewin, Murray et Roger.

Contrairement à l'ego dont se sont emparés les susdits psychologues, le moi que nous avons en vue ici est moins ambitieux; il s'attache aux réalités immédiates. C'est ainsi qu'il est amené à poser des miens qui n'ont pas la prétention de refléter exactement ses jugements de valeur. Un tel moi, fait ce qu'il peut. Il est empirique avant tout, c.à.d. limité par le milieu physique et psychique dans lequel il se meut. Comme le disait déjà Plotin, il se procure ce qu'il peut, et conserve ce qu'il a (lucrum quidquid est, id domum trahere oportet). D'ailleurs l'idée de la valeur

comporte plusieurs acceptations. On distingue notamment la valeur d'estimation de celle d'usage, le désiré du simple utile.

Le susdit ego d'Allport est-il le fruit de la métaphysique?

Nous ne le pensons pas. Il dispose des attributs ou des critères d'un moi empirique, tels que l'extensibilité, la réductibilité, le tonus émotionnel, etc. De plus, Allport en a fait un objet d'expérimentation sur une vaste échelle.

Pour mieux saisir la différence entre le moi et l'ego, il y a lieu d'admettre avec Allport l'existence des inspirés de haute classe que l'on nomme «ego-men». Allport en fait mention au paragraphe «Industrial Psychology».

A ce propos, nous sommes heureux de pouvoir présenter ici un «ego-man» authentique. Il pourrait, nous semble-t-il, illustrer avantageusement sur ce point la pensée d'Allport. Il s'agit d'Auguste Detoef, l'ex-président du Syndicat des Constructeurs électriques et dirigeant de la Compagnie Alstom, dont ses collaborateurs et admirateurs ont eu la délicate pensée, en manière d'hommage posthume, de rééditer les fameux *Propos*, parus en 1937. Dans la préface consacrée à l'ouvrage réimprimé (Editions du Tambourinaire) Pierre Brisson, lié d'amitié avec Detoef, évoque cette personnalité chez laquelle la pratique des grandes affaires n'excluait pas une souriante philosophie. Insoucieux des conventions, des usages et même des commodités de l'existence, d'une parfaite négligence vestimentaire et corporelle, «il était, écrit Brisson, l'exigence même dans l'ordre moral. Son scepticisme, son indulgence si constante à l'égard des autres, cessaient dès qu'il devenait son propre juge... Introduit dans de puissantes affaires, il laissait à d'autres le soin de s'y tailler des fortunes. En se donnant la satisfaction de négliger ses intérêts personnels, il savait qu'il se diminuait dans l'esprit de ses pairs. Il acceptait mal, au fond, d'être tout à fait des leurs».

Voilà un exemple vivant, une preuve expérimentale d'un ego résistant aux tentations d'identification à un milieu qui le tient, mais auquel il est étranger, un cas de non-engagement malgré les apparences contraires. Encore une fois, empiriquement parlant, on fait ce que l'on peut.

Le cas cité se rapporte au point crucial de la théorie d'Allport: les huit conceptions de l'ego relevées ci-dessus ont-elles quelque chose de commun ou suffit-il d'en adopter une seule pour plonger dans l'ombre toutes les autres? A titre d'exemple: l'ego considéré

comme connaisseur est-il le même que celui qui cherche à s'intégrer?

Sans vouloir suivre les sinuosités de la pensée d'Allport sur ce point, disons simplement que, tout comme Blondel, Allport laisse à l'avenir le soin de trancher les questions qu'il soulève, en se confinant dans la prudente réserve du provisoire (voir la conclusion du § 8).

4. *Equipement naturel et artificiel.*

D'où vient cette tendance ténébreuse et profonde de posséder, c.à.d. d'exercer un empire sur les choses, jusqu'à mériter le nom d'instinctive?

Visant à une existence moins dure et plus durable, l'individu, considéré au stade du moi réfléchi, passe à l'action; il cherche à se donner une armature ou un équipement supplémentaire par rapport à celui dont la nature l'a doté.

En être prévoyant, l'individu explore à cet effet son milieu physique et psychique. Par le truchement des jugements de valeur, il sélectionne, pour autant qu'il y a du choix, les choses, les personnes, les groupes, les idées, etc. pour s'en entourer, s'en armer et étendre son empire.

Afin de ne pas s'enchaîner, de ne pas s'alourdir dangereusement, l'individu peut procéder en sens inverse, c.à.d., au lieu d'acquérir, se débarrasser des choses inutiles ou encombrantes. Il peut, de même, se libérer des idées qui ne sont plus de son temps ou qui oppressent le moi au lieu de l'affranchir. Il «remeuble» à cet effet son cerveau par des idées nouvelles ou son cœur par des sentiments différents. Au lieu de s'intégrer par des affiliations, des adhésions ou des participations, il se désintègre, en se séparant, en se divorçant des personnes ou des groupes.

En procédant ainsi, l'individu éprouve le réconfort du sentiment d'apaisement de la détente dans l'attente, un sentiment bienfaisant de sécurité, qui se reflète notamment dans celui de la propriété que l'humanité s'est ingéniée à organiser avec un luxe de précautions et d'attentions.

On qualifie généralement d'instinct de propriété, la tendance à conserver pour soi les objets dont on s'entoure. Cet instinct, si instinct il y a, est dominé par celui de la conservation, qui exige parfois, au lieu d'acquérir, de jeter du lest. Considéré

au point de vue du moi, ce n'est nullement une tendance aveugle et irrésistible. Il faut non seulement pouvoir maîtriser les choses mais encore savoir le faire. Il faut pouvoir et savoir choisir, s'accommoder de la même tendance observable chez les autres, étant donné surtout que le nombre de choses dont on peut disposer est limité. Dans la nature, tout n'est pas aussi abondant que l'eau et l'air, par exemple, ou les bananes chez les indigènes des Antilles, qui les dédaignent, paraît-il, justement à cause de leur nombre. Si les Etats se battent pour la possession de fleuves ou de mers, il n'en est pas heureusement ainsi entre les particuliers. Il en est de même pour l'air. On se bat dans l'air, mais non à cause de l'air qui n'a pas besoin d'être stocké pour soutenir la vie. Il n'en sera peut être pas toujours ainsi: les physiiciens prévoient en effet l'appauvrissement graduel de notre atmosphère en carbone, car celui-ci, en se minéralisant, se dépose au fond des océans. Nous ne sommes plus aux temps préhistoriques où un air riche en gaz carbonique entretenait sur le globe des plantes gigantesques. Bref, pour conserver la vie, il faut à la fois pouvoir et savoir conserver les choses ou, en d'autres termes, posséder un outillage et des provisions. Dans la grande école de la vie, la prévoyance se forme en observant les rythmes dans la nature et chez l'homme, la succession des saisons, celle du jour et de la nuit, de la jeunesse et de la vieillesse, de la santé et de la maladie, de la prospérité et de la crise, de la guerre et de la paix, etc.

Envisagée dans une large perspective, la vie apparaît comme une activité s'exerçant aux dépens ou avec l'aide du milieu ambiant.

Pour durer, la nature nous l'apprend, il faut éviter le contact trop direct avec ce milieu. L'écorce protège l'arbre comme les sens protègent l'animal ou l'homme par l'intermédiaire des organes. Ils permettent d'examiner, de s'enquérir, de mesurer avant d'agir. Considérée sous cet aspect, l'attitude d'exploration est une attitude défensive. Nous sommes cuirassés à cet effet par la nature. Nos organes n'ont pas toutefois la même portée vitale. Ils sont hiérarchisés. Etre décapité est autrement grave que d'être amputé. La nature a doué les êtres d'un organe aussi merveilleux dans son agencement que l'oeil ou d'un équipement qui porte le nom savant d'équipement enzymatique. Il sert à distinguer les phénomènes vitaux des forces chimiques. N'em-

pêche que le roi de la création, grâce à la puissance de son cerveau, s'est créé un équipement à lui, composé d'outillage, d'approvisionnement, etc., qui le mettent mieux à l'abri de l'insécurité et de la dureté de l'existence. A côté de cet équipement matériel, d'autres formes d'équipement non matériel se sont développés. Au stade du moi réfléchi, ils constituent le domaine du mien. Si, au stade qui le précède, on trouve dans le monde animal quelques exemples rares de cet équipement matériel, interprétés d'ailleurs très hâtivement, ils n'ont rien à faire avec la psychologie du mien.

Le cheval est rapide, mais l'homme, muni d'une automobile, le dépasse de beaucoup. L'aigle ou le lynx voit loin, mais l'homme armé du télescope (sans parler de radar) le dépasse aussi.

Le corps humain est susceptible d'être perfectionné quant à sa force musculaire, son agilité, son adresse, mais ce perfectionnement comporte des limites vite atteintes et l'homme préfère déclencher des objets mécaniques dont il n'a qu'à maîtriser les prises, les manivelles ou les boutons de commande. Ce fait lui assure une puissance et une sécurité incomparables.

L'homme est-il arrivé au terme de son équipement physiologiquement parlant?

Dans *Human Destiny*, Pierre Lecomte du Noüy, biologiste philosophe, semble soutenir que l'évolution physiologique aurait comme passé le flambeau à l'évolution spirituelle; les préoccupations d'adaptation à celles de la liberté. L'esprit échapperait ainsi à la contrainte des sens. Dans l'évolution de la vie des êtres, il y aurait lieu de distinguer entre les organes de défense, de chasse, de mobilité et le cerveau qui n'est pas un simple organe d'adaptation mais l'instrument de l'esprit, ce qui permet de distinguer l'utilité de la liberté.

Au point de vue de la psychologie du mien, il importe de ne pas perdre de vue que le corps, considéré comme un instrument organique est à la fois le *senté* et le *sentant*. A ce titre, il appartient plutôt au domaine du *je* qu'à celui du *moi*. Lorsque l'enfant dit: «Roland marche», c'est plutôt «je marche» que «moi marche» qu'il y a lieu de sous-entendre. Pourtant c'est moi-même qui marche, c.à.d. pas un autre.

On identifie trop facilement le corps avec les autres objets de possession. On parle de «mon nez» comme on parlerait de «mon

livre». Pourtant, dans ce dernier cas, le lien d'appartenance n'est pas fatal. Nous nous sommes donc élevés ailleurs contre la tendance à assimiler les deux modes différents d'appartenance (14, p. 441).

Dans «De la propriété» (1849), Thiers s'exprime ainsi: «La première de mes propriétés, dit-il, c'est moi, moi-même... Mes pieds, mes bras, mes mains sont à moi, incontestablement à moi... L'homme a dans ses facultés personnelles une propriété incontestable, origine de toutes les autres... De l'exercice des facultés de l'homme, il naît une seconde propriété qui a le travail pour origine et que la société consacre, dans l'intérêt universel.»

Thiers a tort. Il y a équivoque dans son raisonnement. Entre «ma tête» et «mon chapeau», il y a une différence fondamentale. On ne peut pas ne pas avoir sa tête, mais on peut se passer de son chapeau ou l'aliéner. Nous pouvons échanger des choses, des idées et même des bons procédés, mais jamais des nez, par exemple. C'est sans doute à cause de cette fatalité que la plus belle femme du monde ne peut, dit-on, donner que ce qu'elle a.

Devant son miroir, la belle Cléopâtre pouvait se dire: «Comme je voudrais changer mon nez que l'on trouve trop long!» Et cela avec une impuissance d'autant plus grande que les instituts de beauté n'existaient pas alors. Byron, au visage d'Apollon, regardant ses pieds de faune sentait également une sorte de rage impuissante d'un mien «incontestable», comme le dit Thiers.

5. *Ontogénèse du moi et du mien.*

Notre intention n'est pas d'examiner ici dans quelle mesure l'équipement en question est antérieur, concomitant ou postérieur à la constitution du moi réfléchi. En ontogénèse, on s'accorde que les manifestations du mien précèdent la formation du moi, lequel dépasse, par son ampleur, le domaine des miens multiples et variés.

Déjà au début du siècle dernier, Maine de Biran (17, vol. III, p. 341) a posé l'effort musculaire, qu'il qualifiait du «fait primitif», comme base de sa doctrine du moi.

Préoccupé de la distinction fondamentale entre le moi actif et le moi passif, de l'alternance de domination du corps et de maîtrise de soi, Maine de Biran (5, vol. II, p. 626) attribuait

à l'effort musculaire un rôle primordial dans la formation du moi. D'après lui, c'est dans l'effort musculaire que le moi se connaît immédiatement comme une force hyperorganique produisant le mouvement d'un muscle; le moi ne se connaît qu'à titre de cause agissante sur une matière qui lui résiste; il n'y a pas d'intuition du moi par lui-même ni de conscience hors de cette action; supprimez la résistance, vous supprimez la conscience. Il y a dans toute conscience du moi l'union intime de ces deux éléments hétérogènes, une force immatérielle et une résistance matérielle; le moi se saisit comme cause dans l'effort, inséparablement de l'effet qu'il produit.

Un siècle plus tard, la psychologie du moi parle du mien qui serait né, au cours de l'expérience infantile, du sentiment de la maîtrise que l'enfant exerce sur les objets qui l'entourent (11). Avec l'âge, et grâce à l'apprentissage notamment, ce sentiment se fortifie.

Bref, le moi se dégage du mien. La conscience du corps, qui est un «mien» incontestable, précède le sentiment du moi.

6. *Les miens parmi les idées ancrées.*

Comme il a été déjà dit plus haut, si le mien reflète le moi, il le fait d'une manière imparfaite, relative. Si le choix précède la constitution du lien d'appartenance et présuppose la liberté, cette appartenance révèle le choix porté à la seconde puissance, vu que ce choix est enrichi par un lien d'attachement, de fidélité, de loyauté, etc.

A notre sens, le critère du choix dans l'appartenance, si caractéristique dans la psychologie du moi et celle du mien, s'applique parfaitement aux idées choisies à titre d'objet d'appartenance.

La pensée crée le dualisme du sujet et des objets de la pensée. Si le moi est considéré comme sujet actif de la pensée, l'idée peut être admise comme l'objet de l'appartenance. Ce ne sont toutefois que les idées ancrées que le sujet ou le récepteur considère comme siennes et non toutes celles qui passent par son cerveau au hasard du cheminement de la pensée errante ou mal maîtrisée.

De l'avis général, les idées protégées peuvent dépasser la vie du cerveau qui les a émises. C'est notamment la raison intime,

de l'indignation qui se manifeste en France contre l'amputation des oeuvres littéraires publiées sous forme de «condensés».

Les idées, même mal incorporées, comme par exemple celles qu'on émet au cours d'une conversation ou d'une discussion, deviennent néanmoins des objets de références, du moment que l'émetteur y a attaché une valeur prospective. Pauvre en invention, il est d'autant plus prompt de crier «au voleur». On est jaloux d'une idée émise, d'une phrase faite. On voudrait établir entre le sujet et son fruit qualifié d'intellectuel un droit d'exclusivité, un droit de propriété, protégé si possible par la loi.

Il n'est pas indispensable que l'idée émise soit incorporée d'une manière quelconque pour mériter la protection tout au moins de l'opinion publique, qui se montre, en cette matière, d'une hypersthésie remarquable. La Bruyère, Anatole France, André Gide et tout récemment encore Marcel Jouhandeau (10), par exemple, critiquent cet état d'esprit excessif. Pour Gide, en imitant, on peut rester créateur. A moins d'être tromperie pure et simple, le plagiat trouve des défenseurs notamment chez La Bruyère dans son «Apologie pour le plagiat» (Vie Littéraire, vol. IV). Quant à Jouhandeau, il proclame sans ambages que «les mots sont à tout le monde, les sujets ne s'inventent pas de toutes pièces et les idées ne sont à personne».

A supposer que l'on puisse établir strictement l'origine des idées émises, il serait absurde de vouloir les attribuer à un seul cerveau privilégié. Rien que l'idée de l'universalité de la conception du vrai s'y oppose déjà. «Aucun homme, disait Anatole France, ne peut se flatter raisonnablement de penser quelque chose qu'un autre homme n'ait pas déjà pensé avant lui».

C'est parce qu'on se défie souvent de sa propre originalité que l'on cherche avec avidité le moyen d'asseoir mieux sa propre pensée en recourant aux citations.

Quelle érudition, quelle patience de moine ne faudrait-il pas pour tracer le pedigree de tous les «miens» choisis ne fût-ce que par les véritables penseurs dans le domaine de la pensée prospective! Encore une fois, on fait ce que l'on peut, on ne refuse pas d'une manière absolue de tenir compte de l'exigence de la conscience universelle d'accorder une reconnaissance à ce genre de „miens”. C'est ainsi qu'au XX-ème siècle les textes d'articles et d'ouvrages se sont alourdis de tant de références que les éditeurs ont dû recommander aux auteurs de renvoyer

ces références en bloc à la fin de leurs travaux sous forme de liste bibliographique.

7. *Le moi rétrospectif.*

Comme l'a montré expérimentalement F. C. Bartlett (3), la mémoire n'est pas étrangère au sus dit choix. Plus précisément, elle est affectée par le «cultural background» (p. 64), sorte de fonds culturel de l'individu. C'est aussi le sens des investigations de Levine et de Murphy (13) que l'oubli aussi bien que le souvenir sont fonctions d'identification du moi.

Le souvenir d'avoir connu des heures semblables ou différentes est si fortement enraciné en nous que nombre de psychologues ramènent le moi ou le je à la conscience de ses états antérieurs (Blondel, 4, p. 550). Toutefois, ces souvenirs pour résister à l'amnésie, au rétrécissement du domaine du moi, doivent sans doute pouvoir conserver un sens pour l'avenir ou tout au moins pour le présent. J'en vois une preuve nouvelle dans le confession spontanée faite par Winston Churchill dans ses «Mémoires de Guerre» (chap. XXV) à propos de sa visite à la «Home Fleet» à Scapa Flow, en septembre 1939. «J'avais écrit-il, l'impression de me réincarner en un ancien moi-même. A me voir dans une situation que j'avais longtemps auparavant, il me semblait que j'étais le seul survivant d'une époque. *Mais non, les dangers, eux aussi, demeuraient*» (italiques de l'auteur).

8. *Posséder, appartenir et s'appartenir comme formes du mien.*

Pour distinguer le maître de l'esclave dans l'appartenance, on peut se référer à la distinction entre l'aspect positif et l'aspect négatif dans la possession.

Il faut souligner toutefois l'intérêt qu'il y a à distinguer dans les rapports d'appartenance l'aspect actif et l'aspect passif, sans oublier le sens réfléchi: celui de s'appartenir.

S'appartenir veut dire rester libre et indépendant. C'est aussi pouvoir se maîtriser, ce qui veut dire que la liberté n'est nullement anarchique par son essence, mais discipline consentie. Dans les identifications sociales, cela revient à la faculté d'entrer et de sortir, sinon c'est la prison, le camp de concentration ou autre dégradation.

Contrairement à la possession, qui est une attitude active par sa vigilance, l'appartenance (belongingness) peut être envisagée comme une attitude passive. A côté d'un moi pensant, se développe un moi agissant visant à la stabilité et à la sécurité. Actif ou passif, le moi tire un réconfort bienfaisant de la possession ou de l'appartenance par le truchement du sentiment de la détente dans l'attente.

La femme dont le moi a le sexe de son corps ressent le désir ardent et intime d'être possédée, ce qui ne veut pas dire qu'elle ne soit pas capable de se reprendre. Son instinct lui révèle que pour posséder, elle doit appartenir à l'homme en tant que mâle plutôt qu'un tant qu'homme d'action ou artiste. C'est par le sentiment de sécurité qu'elle éprouve un réconfort de se sentir appartenir. Inquiète et tendre «suis-je tienne?», interroge la femme aimante.

Quant à l'homme, s'il n'est pas réfractaire ou immunisé contre les pièges de la gloire ou de la vanité, il ne dédaigne pas d'être élu, connu ou reconnu, admis ou accepté ou simplement décoré. Ce ne sont d'ailleurs pas les seules formes du refuge ou de la capitulation du moi mâle, résistant mal aux attraits de la gloire dans des moments de défaillance ou de faiblesse. Les vrais lutteurs, par contre, ne se laissent pas embaumer de leur vivant dans la myrrhe des louanges et de la gloire.

Au point de vue de l'affirmation du lien d'appartenance «le Roi des Belges» est autre chose que «le Roi de Belgique».

En insistant sur l'origine divine de sa royauté, Louis XIV affaiblissait le lien d'appartenance qui le rattachait à son peuple. Il oubliait qu'il était avant tout le Roi des Français. «Louis XIV, devenu Dieu, écrit Romier (19), la multitude se prosterna, mais comprit que le roi ne lui appartenait plus. Or, le Français n'aime bien que ce qui lui appartient».

9. *Le moi riche et le moi pauvre.*

Ce serait une erreur de déclarer que le moi enrichi ou appauvri par ses conquêtes ou par ses pertes, s'identifie avec ces dernières. Il en reste distinct. Les spirituellement pauvres sont souvent favorisés au point de vue matériel. A priori, il n'y a pas lieu de déclarer intégralement indigent le moi d'un Diogène, par exemple, qui dans son désintéressement total pour les choses qui passionnent tant d'autres, décida de vivre dans un tonneau.

Il en est de même du sage Socrate, qui à la vue des souks d'Athènes, s'écria: «Que de choses dont je n'ai pas besoin!»

En principe, le moi d'un désabusé ou d'un cynique est plus pauvre spirituellement parlant que celui d'un enthousiaste ou d'un inspiré. Il peut en être différemment matériellement parlant. La grandeur d'un être, disait Amiel, est proportionnel à ses besoins. «Dis-moi ce que tu désires et je te dirai ce que tu es». Ceci exige un commentaire.

Si l'on se tourne vers les poètes, citons l'indifférent Piron, qui refusa de faire une démarche qui lui aurait rapporté une pension.

— Pourtant vous n'êtes pas riche, remarque Crébillon.

— C'est vrai, mais comme je m'en moque, c'est comme si je l'étais.

Regnard, son contemporain, abondait dans le même sens en disant: C'est posséder les biens que savoir s'en passer (Joueur, VI, 13).

L'écrivain J. K. Huysmans était plus exigeant sous ce rapport.

Habitant chez les soeurs Bénédictines, il fait cette confession: «Jamais, exceptant les heureux des offices dans la chapelle, je ne fus aussi malheureux. Je n'avais plus rien, ni livres, ni bibelots, ni habitudes, ni amis».

Les Spartiates ont fait de nécessité vertu et Solon dit au riche Crésus que nul homme, avant sa mort, ne pouvait se vanter d'être heureux.

Riches en choses, mais pauvres en idées. On peut discuter le point de savoir si la pauvreté ou la faiblesse physique incite la spiritualité ou en éloigne. Il y a peu de philosophes ou de poètes parmi les footballeurs et inversement. Ce qui est certain, c'est qu'une littérature contrôlée ou une science engagée, c'est à dire privée de liberté, est chétive, peu engageante et vouée à la mort. Bannir l'art pour l'art revient à réduire le moi à son aspect social, à le décapiter de la personnalité individuelle.

Pour éviter le danger auquel s'expose celui qui embrasse tout mais étreint mal, l'individu est sensé partager, disloquer ses intérêts, en accusant ses préférences en fonction de sa nature intime.

Le détachement du matériel dont il était question, si imparfait qu'il paraisse, et que l'on observe chez ceux qui ne résistent pas au démon du désintéressement, peut provenir de l'attache-

ment à la liberté. A force de s'attacher aveuglément à son bien, l'individu s'enchaîne et devient son propre esclave. «Possesseur de la terre, l'homme est possédé par la terre, dit Emerson (Conduct of life: Wealth)». Selon Sénèque, on nage mieux sans bagage (Nemo cum sarcinis enatat). Dans *Paradoxa*, Cicéron envie celui qui porte avec lui tout ce qu'il possède (omnia mea porto mecum).

Ayant pris les moyens pour le but, le cupide, le rapace, l'avare appauvrit son moi.

«Autant tu possèdes, autant tu vaux», remarque Cervantès dans *Don Quichotte* (Pt. II, ch. 20). Aux yeux de la foule, la considération dont jouit l'individu est fonction de cette équation.

On rencontre parfois de ces natures surprenantes, à la fois farunches, extérieurement démunies mais riches d'une vie intime et libres par dessus tout. Par souci de cette liberté, elles redoutent de s'enchaîner par des objets, des relations ou des doctrines. Contrairement à ceux pour lesquels les attaches ou les chaînes sont autant de raisons de vivre, elles préfèrent le dénuement, l'exil volontaire ou l'isolement dans le repliement sur soi-même. Se vouant quasi exclusivement à la vie de l'esprit, ils négligent les exigences matérielles et sociales de l'existence. Détachés de l'extérieur par l'esprit d'indépendance et de liberté, cuirassés par une fierté ombrageusement isolante, il n'y a pas lieu de les confondre avec les sceptiques, les désabusés ou les cyniques, qui se sont appauvris par manque de foi. Tandis que ces derniers sont spirituellement, pauvres ou appauvris, les premiers ne s'appauvrissent que par une sorte d'esprit stoïque, qui les rend indifférent à la fortune, la santé, la douleur ou les honneurs, les liens sociaux ou mondiaux. Il y un moi volontairement comprimé, privé de sa force expansive et affective. Ici, le moi et le mien se présentent sous un jour spécial.

Afin d'intégrer les masses, l'homme d'Etat pose des valeurs et prétend que lui seul ou les siens les incarnent. On s'accorde toutefois plus facilement sur le choix d'idées que celui des personnes qui les représentent. C'est la raison d'être des élections. La fidélité aux idées n'équivaut pas nécessairement à la loyauté aux hommes qui prétendent les incarner, d'où les scissions, les désertions, les trahisons.

Pour conclure, disons qu'un lien possessoire n'est qu'un critérium relatif du moi au point de vue de sa valeur révélatrice.

Un violon pendu au mur dans le logis du mélomane, qui crève les yeux aux canaris pour qu'ils chantent mieux dans leur détresse, est trompeusement révélateur quant à la nature tendre de son possesseur. Un simple regard de tendresse humaine, surpris sous le front pensif d'un interlocuteur, peut s'avérer sous ce rapport plus éloquent et moins trompeur. D'ailleurs, l'homme voué à une existence sociale, excelle dans le maniement d'un mécanisme d'inhibition, qui lui permet de dissimuler son moi. Le coeur n'est pas transparent, dit-on. En se masquant, l'homme prend l'apparence d'un autre que lui-même. Pour échapper à la désapprobation sociale, le cupide, l'avare, le parcimonieux ne s'avoue ni aux autres, ni à lui-même. Haï ou critiqué, il s'efforce de passer pour économe, prévoyant, etc.

Il est utile d'avoir ces réserves présentes à l'esprit pour interpréter le moi sur la base de «miens» multiples et variés qui sont sensés le refléter plus ou moins. On est forcé cependant d'y avoir recours car il est malaisé d'étudier le moi en soi.

10. *Le domaine du mien et le terme d'engagement.*

Dire que le moi enveloppe le mien (James) ou qu'il s'étend ou se prolonge dans le mien (Blondel) ne caractérise pas assez, à notre sens, le psychisme de l'appartenance, qui s'exprime notamment dans la stabilité du lien. Il ne suffit pas dans l'appartenance de saisir ou de tenir un objet, il faut y tenir, c.à.d. continuer à le faire. A cet égard, le terme d'engagement (involvement) paraît critiquable.

Si on peut convenir qu'en psychologie contemporaine on préfère parfois employer le terme d'ego plutôt que celui du moi, à cause de certaines associations métaphysiques ou religieuses qu'il comporte, il faut, semble-t-il, décourager l'emploi du terme engagement comme ne pouvant s'appliquer à l'ensemble des objets sur lequel l'empire du moi est sensé s'étendre.

Pour notre part, c'est par ce choix peu heureux du terme que nous nous expliquons le fait curieux que dans la psychologie du moi ou de l'ego les objets matériels, sans être exclus, sont relativement négligés ou rejetés dans l'ombre. C'est que le terme d'engagement qui s'applique merveilleusement à l'incorporation, l'affiliation, l'enrôlement, l'endoctrinement ou l'encasernement sonne mal quand il est question des objets matériels. En effet, il est malaisé de penser ou de parler d'engagement quand on

fait le choix d'un rasoir, d'une machine à écrire, d'une voiture ou d'un autre objet d'équipement. A plus forte raison, il ne peut y avoir d'identification, terme qui se prête plus particulièrement aux liens établis avec les personnes, les groupes, les oeuvres ou les idées.

Le choix du terme d'engagement pour couvrir tous les domaines où le moi se trouve impliqué est sans doute responsable de la tendance, en psychologie du moi et de l'ego, à mettre l'accent davantage sur le social que sur l'individuel et même à négliger ce dernier.

Cette tendance est regrettable car l'individu ne vise pas uniquement à s'engager mais également à se dégager. C'est surtout par l'acquisition des objets matériels que l'individu affirme avec force son droit indestructible à l'indépendance et à la liberté, malgré les exagérations que cette affirmation peut comporter. Le désengagement, cette affirmation de soi, révèle la détermination par soi-même. Elle ne doit pas être confondue avec l'insoumission ou l'insubordination qui correspond à l'excès de l'affirmation du soi.

Le choix du terme d'engagement semble expliquer également le silence relatif dont la psychologie du moi entoure les tendances aux désintégrations sous ses formes diverses, tendances opposées à celles d'intégration. Ces dernières s'expriment dans les identifications, et les premières dans les différenciations.

A côté de l'incorporation du sujet dans l'objet, sous forme d'identification, comme dans l'expression «le moi c'est un autre», on trouve le moi qui se pose en s'opposant (mon pays et moi, mes chevaux et moi, etc.). Elles sont probablement délaissées parce qu'elles se placent en marge des «miens» sociaux. Elles prennent la forme de l'opposition du moi individuel contre l'emprise sociale inutile ou intolérable. On ne quitte pas une union pour s'engager nécessairement dans une autre. On se donne parfois du répit, on rompt radicalement avec le passé. Riche en souvenirs, une veuve hésite à recommencer. Le mariage n'est pas toujours une forteresse assiégée, comme le veut le proverbe français qui dit que «ceux qui sont dehors veulent y entrer et ceux qui sont dedans en sortir».

Le divorcé, qui se refuse à récidiver, n'est pas nécessairement celui qui se propose de joindre le club des célibataires. Sans être anti-sociale, son attitude ressemble à une désintégration

ferme et réfléchi sur un point particulier du comportement social. Tout n'est pas intégration, enrôlement, claustration, coterie, chapelle ou cabale dans la vie de l'individu intégré dans la société. A côté du social accapareur, persiste l'individuel indestructible.

A la Chambre Britannique, lors du vote sur la suspension de la peine du mort, les partis politiques décidèrent que le vote serait libre, c.à.d. que les députés voteraient selon les impératifs de leur conscience propre et non d'après les directives de leur parti. Preuve péremptoire que les intégrations sociales non seulement n'excluent pas l'autonomie individuelle, mais que cette dernière jouit même de la reconnaissance sociale.

Loin de s'opposer d'une manière irréductible au social, l'individuel peut le guider, le sauver.

En présence d'une crise politique, économique, sociale, les masses inquiètes et désemparées, s'agitent dans un monde où rien ne rime à rien; elles se tournent avec anxiété vers les individus.

André Gide, lauréat du prix Nobel de littérature pour 1947, approuve cette attitude et proclame, du haut du socle où il a été hissé: «Le monde sera sauvé par quelques-uns!»

Sauvé contre quoi? Sauvé contre l'assujettissement.

Signalons en passant que les problèmes d'identifications sociale se compliquent singulièrement quand les identifications s'excluent ou quand il y a lieu de les hiérarchiser en cas de conflit entre deux appartenances.

En cas de crise nationale ou internationale, un catholique, un socialiste ou un communiste est-il tenu en conscience de subordonner sa conduite au loyalisme envers son pays ou envers son parti?

Dans «Entre les Pyrénées et Gibraltar», Serrano Suner, l'ancien ministre des affaires étrangères d'Espagne, est à ce propos amené à faire cette réserve: «Dans les pages qui suivent, Dieu voudra que je ne faillisse ni à la loyauté que je dois à mes convictions, à mes amitiés et à moi-même, ni moins encore à celle que je dois à mon pays. Et ma sincérité n'y trouvera qu'une limite: celle-là seule que ces deux loyautés m'imposent. Limite quantitative et non qualificative. J'entends par là que je ne me propose de dire, dans mon livre, que ce qui est conforme à la vérité, mais non pas toute la vérité, parce que — plus

spécialement dans l'ordre de la politique interne de l'Espagne — je le juge inutile et, en quelque mesure, inopportun.

Pour conclure, la grande forêt des «miens» emperiques, qui s'expriment dans les liens possessoires, n'est pas cachée uniquement par les arbres de la métaphysique. Elle l'est également par l'emploi des termes qui offrent l'inconvénient de vouloir déblayer le vaste champ d'observations des «miens» variés sous l'égide d'une conception trop restreinte, qui est celle d'engagement. Il y a des mots qui loin de clarifier les concepts les trahissent faute de précision indispensable.

Bruxelles, Juin 1948.

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CONSCIOUSNESS AND THE UNCONSCIOUS IN DEPTH AND GESTALT PSYCHOLOGY¹

by

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I. INTRODUCTION AND PRELIMINARY DEFINITIONS

Whoever undertakes to discuss basic questions concerning consciousness and the unconscious and their relations to each other cannot avoid the necessity of prefacing some termino-

¹ This article represents a considerably extended version of a paper on "Bewusstsein und Unbewusstes im Lichte der Gestaltpsychologie" delivered on May 6, 1946, before the Schweizerische Gesellschaft für Praktische Psychologie in Zürich and again on November 22, 1946, before the Psychologische Gesellschaft in Bern. Chapter VII is wholly new.

logical remarks. The expressions "consciousness" and "the unconscious" shimmer kaleidoscopically both in professional and lay use in a chaotic manifoldness of meanings. It cannot be our task here to exhibit all the significances and nuances of these words, which would call for a treatise in itself. Attempts to distinguish some of the principal ones have been made by Schultz—Hencke² and Brinckmann.³ Especially the latter has analyzed the concept of the unconscious historically and has shown that it has been variously considered as a system of a 1. spatial-material, 2. perceptive, 3. apperceptive, 4. vital (i.e. predominantly irrational and more or less vitalistically colored) kind. In tracing the evolution of the concept from author to author and from epoch to epoch he has, however, touched only briefly upon the problem of the manifold meaning of the word in one author or in the common usage of a school, with which we shall be concerned principally here. A dawning recognition that the indiscriminate employment of the word "unconscious" leads to untenable consequences is to be found in Gibb's book *In Search of Sanity*,⁴ in which the author very properly points out that the customary designation of such structures as dreams and visions and their like as "unconscious", while they present themselves in all clarity and impressiveness to consciousness, is an absurdity.

If we consider briefly and provisionally the word "consciousness", we find that it is used to denominate 1. a quality of certain psychic contents or events, or 2. that portion of the psyche whose contents are characterized by the aforementioned quality, or 3. a psychic system more or less coextensive with the foregoing and set off from the remainder of the psyche in addition by certain systemic properties of which we shall speak later. In its first meaning the word often is applied only to the condition of the subject, as when it is asserted for instance that human beings alone "possess consciousness", or when we speak of someone "loosing consciousness", or a "clouded consciousness". Another application of this first meaning is better conveyed, it may be, by the adjective "conscious", as

² Schultz—Hencke, H. W.: "Das Unbewusste in seiner mehrfachen Bedeutung". *Zentralblatt für Psychotherapie* XII (1941), Heft 6, 336—349.

³ Brinckmann, Donald: *Probleme des Unbewussten*. Zürich: Rascher, 1943.

⁴ Gibb, A. S.: *In Search of Sanity*. New York: Farrar and Rinehart, 1942.

when we talk of "conscious actions", "conscious motives", a "conscious decision", or the like, or again in the expression "a consciousness of (e.g. a need, a fact)". In both cases it denotes a capacity of being aware, whether of an object or to a subject. For denoting this capacity or quality the abstract noun "consciousness" and its adjective "conscious" seem best fitted, and we shall use it hereafter, when standing without quotation marks, in this sense.

"Consciousness" signifies not only a quality or capacity of psychic contents (within which contents the phenomenal, conscious subject is included), but also in many cases the sum of those contents to which that quality pertains, or the portion of the psyche including them. It is this meaning which we hear in such expressions as "a broad consciousness", "span of consciousness", "consciousness filled with thoughts of...", etc. Psychology of earlier days used this concept of "consciousness" to delimit its field of investigation, proclaiming itself to be the "study of consciousness". To distinguish it from the first meaning of the term, we employ for this kind of "consciousness" the substantive and call it "the conscious", it being the sum of everything psychic that is characterized by consciousness. We may speak of the conscious, too, as a psychic "region", using this word in no topographical, but in a strictly topological sense, as we have learned to do in psychology from Lewin,⁵ and we shall see that this designation aids us considerably in our thinking.

What we have just said concerning consciousness and the conscious applies in precisely the same way *mutatis mutandis* to "the unconscious", as it is generally called. We shall endeavor henceforth to use strictly symmetrical expressions for symmetrical concepts: "unconsciousness" for the quality or capacity counterpart to consciousness in the above defined sense, and "the unconscious" for the psychic region whose contents are distinguished by unconsciousness.

Nearly all authors assume, more or less implicitly, that the contents of the conscious are characterized by other qualities than that of consciousness, or that the conscious itself possesses peculiar properties that influence all its contents; and the same is true of the unconscious. Sometimes these marks of distinction

⁵ Lewin, Kurt: *Principles of Topological Psychology*. New York: McGraw-Hill, 1936.

are considered to reside in the charges of psychic energy or libido⁶ attaching to the contents of the respective regions, sometimes in a particular organization or systemic character of the regions themselves. We shall see later that such marks of distinction when applied to the regions or to their contents as wholes are misleading, and therefore it will be helpful to introduce at the beginning terms that will enable us to take account of this fact. We need, then, a term for such parts or sub-regions of the conscious as actually do exhibit in addition to consciousness other characteristics such as we are accustomed to associate with our conscious being, and which we may adumbrate for the present with the words *distinctness*, *proportion*, *objectivity*, *reasonableness*, *sobriety*. We also require a counter-term for the corresponding portions of the unconscious endowed with the contrary properties, such as *indistinctness*, *tendency to excess*, *subjectivity*, *irrationality*, *strong emotivity*. . . the Dionysian as contrasted to the Apollonian tone. Not without misgivings, and for lack of a better expression, we shall reinstate here a term fallen for some time into disuse and even into disrepute and call those special portions of the unconscious (or conscious) of which we spoke "the unconscious (or conscious) mind".⁷ In the present state of psychological knowledge we shall not anticipate any difficulty from the hoary objection that mind is necessarily conscious, and that "unconscious mind" is a contradiction in terms. We use the word "mind" here with no other purpose than to suggest the commonly accepted systemic character of the psychic regions so designated, the fact that they exhibit respectively a kind of typical, albeit as yet undefineable organization and coherence. Another possible expression would be the "conscious (or unconscious) system", but this we will reserve for application in a more precise sense later on. On the

⁶ "Libido" is employed here and throughout in the Jungian sense of unspecific psychic energy, not in the Freudian of specifically sexual energy.

⁷ In the original German paper we called "consciousness" and "unconsciousness" "Bewusstheit" and "Unbewusstheit", "the conscious" and "the unconscious" were called "das Bewusste" and "das Unbewusste"; and for the "conscious mind" and the "unconscious mind" the words "Bewusstsein" and "Unbewusstsein" were available. English, less abundant in abstract expressions, affords us no simple noun for this third sense of the paired concepts, and so we are forced to redefine an existent but not wholly adequate term.

other hand, we shall allow ourselves to refer to the conscious mind and the unconscious mind for the reasons just given as systems, although it will be possible only toward the end, after the consideration of many preliminary questions, to delimit and define them somewhat more closely. Under "system" or "organized region" we understand as usual in science the property that the parts of this more or less closed and structured whole stand in no merely arbitrary relation to each other, but so that an alteration in any one part has as a consequence regular and definite alterations in the others.

The definitions advanced in this introduction are altogether provisional, drawn from common usage, and intended only to make possible a first rough orientation in a field which it is the purpose of the following chapters more carefully to survey. When we employ the still more ambiguous words of our title in the traditional manner, without distinction of meanings, for the sake of their manifold connotations, and in order to make contact with the literature, we shall inclose them in quotation marks and speak of "consciousness" and "the unconscious", leaving the quotation marks away when the words are utilized in the narrower senses stated above. Our terminology, while it may present some difficulty at first, will recommend itself, I hope, at the outset through the clear symmetry of the expressions chosen and subsequently by virtue of the conceptual clarification that it permits.

II. CONSCIOUSNESS AND UNCONSCIOUSNESS: THE QUALITIES

1. In Psychoanalysis

The distinction between consciousness as a mere quality or capacity on the one hand and the conscious or the conscious mind as a region or system on the other is not new, although we have drawn it here perhaps more sharply than hitherto. Writing in 1913 Freud closed his paper entitled "Some Remarks on the Concept of the Unconscious"¹ with the words:

¹ Freud, Sigmund: "Einige Bemerkungen über den Begriff des Unbewussten", First published in the *Internationale Zeitschrift für Psychoanalyse*, Vol. I, 1913. Quoted from *Gesammelte Schriften*, Vol. VIII, p. 438. London: Imago, 1943. As English editions of Freud's works were not available to me, I have translated all quotations myself from the German, adhering as

"Unconsciousness (*das Unbewusste*) seemed to us at the beginning a mysterious characteristic of a certain psychic process. Now it means more to us, it is a sign that this process participates in the nature of a certain psychic category known to us through other, more significant qualities, and that it belongs to a system of psychic activity that deserves our fullest attention. The value of unconsciousness as an index has left its significance as a quality far behind." A passage written two years later in an essay on "The Unconscious"² reveals his initial hypothesis more distinctly: "On the other hand it is certain that they [the "latent states of mental life"] possess the most extensive contact with the conscious psychic processes; through the expenditure of a certain amount of labor they can be transformed into them, they can be replaced by them, and they can be described with all the categories that we apply to conscious psychic acts, such as ideas, strivings, decisions, and the like. Indeed we may say of many of these latent states that they are distinguished from conscious ones only by the absence of consciousness."

In the second quotation it is evident that consciousness and unconsciousness are regarded as specific but hardly defineable qualities that can pertain to the most various psychic contents, regardless of the nature of the latter. This stands in some contradiction to the earlier passage, in which the two qualities were signs indicating that their bearers belonged to a particular system characterized obligatorily by yet other and more important properties. No distinction was made between region and system, although the possibility of so doing was implicit in the passage from 1915. This led to difficulties which Freud himself realized and attempted in the same essay to deal with. We will consider the relevant passages later on; for the present it suffices to note that the conception of consciousness and

closely as possible to the generally used terminology, but rendering the words "Bewusstsein", "das Unbewusste", etc. so far as possible in a manner consonant with our definitions. Where the word employed by Freud differs from the term we have suggested to cover the same sense (cf. footnote 7 on p. 4), we have added in parentheses the German expression that he uses, wherever the discrepancy seems significant.

² Freud, Sigmund: "Das Unbewusste". First published in the *Internationale Zeitschrift für Psychoanalyse*, Vol. III, 1915. Quoted from *Gesammelte Schriften*, Vol. X, p. 267. London: Imago, 1946. Referred to hereafter only by the title of the paper.

unconsciousness as psychic qualities with various possible substrata is implicit in Freud's writings. Overleaping the development of psychoanalytic theory in the intervening years, we encounter this conception again in the most recent comprehensive presentation of psychoanalytic psychology, that by Fenichel,³ when he says, "In the exposition of the dynamics and economics of the mental organization, nothing has been stated as yet about the significance of whether a given phenomenon is conscious or unconscious. This is due to the fact that the differentiation is initially purely descriptive, not quantitative....", and a little later, "Returning to the quality 'conscious', the fact whether or not an impulse is conscious reveals nothing of its dynamic value".

At this point we shall turn our attention to an author who does not belong to psychoanalysis strictly speaking, but upon whom Freud exercised a deep influence, and whose own theory of consciousness largely determined Jung's theoretical conceptions, which we shall scrutinize in the following section. Eugen Bleuler was not only the conceptual, but also the personal mediator between Freud and Jung, a first energetic champion of Freud almost alone among academic psychiatrists, and at the same time Jung's teacher. His *Naturgeschichte der Seele* occupies a noteworthy place as one of the first attempts at a comprehensive synthesis between the new discoveries of depth psychology and "normal" psychology, i.e. with the traditional psychology of the conscious mind and with the facts of clinical psychopathology. We find there too the recognition of consciousness as a quality, hard to define or explain, of psychic events:⁴ "What is supposed to be something special and seems to defy every explanation is the conscious *quality* of psychic events, what distinguishes the psyche as a feeling and consciously acting subject from an automaton, inner perception, or however one prefers to name this property. *This conscious quality we denote with the name of consciousness....* A sensation, a motive can

³ Fenichel, Otto: *The Psychoanalytic Theory of Neurosis*. New York: Norton, 1945. Pp. 14—15. Quoted in the following only by the name of the author.

⁴ Bleuler, Eugen: *Naturgeschichte der Seele und ihres Bewusstwerdens. Eine Elementarpsychologie*. Berlin: Springer, 1921. P. 37. Italics in the original.

be conscious or not, as a tree can be seen or not.... I, a subject, am conscious of a process; an object, a process, is conscious to me. The quality of consciousness does not exist like the quality of green by itself....but behind it there must be, as in every act (e.g. seeing), a subject....and, as in every transitive act (seeing, being seen), an object (that is seen). Consciousness without content exists just as little as form without content." In later years we find the same view represented in his textbook of psychiatry: ⁵ "We thus understand under the customary expression 'the conscious' (*Bewusstsein*) as under 'consciousness' (*Bewusstheit*) not processes, but the conscious *quality* of a psychic complex of events. We must contrast with this quality the lack of consciousness in other processes, which we call 'unconscious'." The nature of consciousness as a purely qualitative characteristic is set forth still more emphatically in a subsequent passage: ⁶ "Not the creature, not the brain possesses consciousness, but a complex of central nervous functions, which we localize in mammals in the brain cortex. There is no *res cogitans*, but a *functio cogitans*." Consciousness and unconsciousness are with him, as we shall later see, functional qualities in a double sense: they describe an aspect of certain functional relations, and they are conditioned wholly upon the presence of these relations, having no existence as attributes of any substrata apart from them. What these relations are, we shall see in a following chapter.

2. In Analytical Psychology

Jung scarcely can be said to have developed a theory of consciousness in the abstract. Although his works abound in passages wherein the contrast between "consciousness" and "the unconscious" is put with all possible sharpness, it is always with the aim of demonstrating what is contained in, or what happens in the two psychic realms, and speculations as to other possible differences are dismissed as in the following sentence: ⁷ "The

⁵ Bleuler, Eugen: *Lehrbuch der Psychiatrie*. 6th ed. Springer, 1937. P. 3. Italics in the original.

⁶ *Naturgeschichte der Seele*, p. 41.

⁷ Jung, C. G.: *Psychological Types*. Translated by H. Godwin Baynes. New York: Harcourt Brace, 1923. P. 613—4. We have utilized the English editions of Jung's works for the purpose of quotation as far as possible,

concept of the unconscious is for me an *exclusively psychological concept*, The question as to the state in which an unconscious content exists, when not attached to the conscious (*Bewusstsein*), is withheld from every possibility of cognition. It is, therefore, quite superfluous to hazard conjectures about it." The juxtaposition of the phrases "an unconscious content" and "not attached to the conscious (*nicht ans Bewusstsein angeschlossen*)" carries the suggestion of a quality that is gained or lost through association with a particular system or group of psychic contents, but we hear nothing of a quality of consciousness or unconsciousness as an independent concept. When we come to discuss the regions of the conscious and the unconscious, we shall see that they are implied in certain of Jung's utterances, and therefore we shall postpone further discussion until that place. Although Jung does offer a definition of consciousness, it is in terms of the *conditions* of consciousness, on which account its treatment too must be left until later.

3. In Gestalt Psychology

Gestalt psychology knows no so-called "unconscious". Unconscious processes or contents belong according to it to the physiological field, as conscious processes and contents likewise do; only to the latter pertains the property of consciousness. The fundamental similarity, the field character of both kinds of processes becomes clearly evident in the following quotation from Koffka: ⁸ "The forces which determine our behavior may not always be those we believe to be the determinants.... Psychoanalysis in its various forms has brought to light many such facts, and perhaps its general tendency may be said to be the proof that all our actions are of that type, reducible to a very few subterranean forces totally absent from our behavioral field. However far the psychoanalysts may overshoot the mark, it remains true that this type of action exists, that it cannot be explained in terms of behavioral environment, and that it is

but have permitted ourselves to alter the renderings of "*Bewusstsein*" and "*das Unbewusste*" wherever necessary into conformity with our terminology, as explained in Footnote 1 to page 6.

⁸ Koffka, Kurt: *Principles of Gestalt Psychology*. New York: Harcourt Brace, 1935. Pp. 50—51.

so similar to the rest of behavior that it needs a common explanatory concept. Since the field concept is applicable to all behavior, it appears again that the psychological field cannot be identical with the behavioral environment."

As we shall have occasion in the following to use repeatedly certain basic concepts contained in the quotation, let us pause here to elucidate them briefly. "Behavioral environment" is Koffka's rendering of the nearly untranslatable term *anschauliche Umwelt*, which runs through most of the original literature of Gestalt psychology. Now, *anschauen* means simply "look at", and the *anschauliche Umwelt* is the environment as we look at it, as it presents itself to us without reflection, and as we, regarding it thus immediately and naïvely, spontaneously react to it. One could translate it more or less by "phenomenal environment" if the word "phenomenal" were not too overlaid with philosophical connotations. The rendering into "behavioral environment" takes account of the fact that it is the immediate aspect of a thing that as a rule determines our actions in regard to it, our behavior, whether this "thing" be given in outer or inner experience. *We look at it as this or that and behave accordingly.*

The concept of the field is a fundamental one in Gestalt psychology and is formed in exact analogy to the field concept in physics. Its essential feature is that inhomogeneities, stresses, or disturbances in any part of the field are able to influence immediately all the other parts. The indispensableness of this concept in psychology and its experimental justification have been presented brilliantly and in such detail by Köhler⁹ in a recent work that we shall not enlarge upon it here.

In the cited passage from Koffka we are thrust back upon a psychophysical or physical, i.e. physiological field concept. That this field includes both unconscious and conscious processes is shown in another quotation from the same author:¹⁰ "The disappearance of the Ego from the behavioral world does not mean for the normal adult an annihilation of the Ego. It survives as a part of the psychophysical field even when it is not represented in consciousness [i.e. in the conscious],.... From the point of view here defended the mental or, if you like, the

⁹ Köhler, Wolfgang: *Dynamics in Psychology*. New York: Liveright, 1940.

¹⁰ Loc. cit., p. 330—331. Cf. also p. 66—67.

behavioral aspect transcends the phenomenal, the conscious, the latter being always but a small fragment of a much larger event." Metzger¹¹ denies explicitly that the psyche is to be equated with conscious experience: "The theory according to which reciprocal understanding between men depends on after-feeling . . . rests upon a phenomenological error, which in turn springs from the old and false equation of mind and consciousness in the sense of inner experience." Another sentence of Metzger's shows that psychic Gestalten (in the technical sense) are not to be found only in the conscious:¹² "Thus in the case of recognition we evidently have a kind of pair formation between the perceptual Gestalt and the trace Gestalt, wherein the latter, it is true, remains as such outside of the conscious."

Gestalt theorists confess openly that the quality of consciousness to be met with in the field is undefineable, indeed that its presence or absence is not even objectively demonstrable. Thus Koffka¹³ writes: "True enough, this conscious side of the [physiological] processes does not enter into our causal explanations, but it has to be recognized as a fact nevertheless. And that leads to the conclusion that it is of the warp and woof of certain events in nature that they 'reveal themselves,' that they are accompanied by consciousness. Why they are so, and what special characteristics a process must have in order to be so, these are questions that cannot now be answered, and perhaps may never be." For Gestalt psychology exists then primarily a physiological or psychophysical field, within which the region of the conscious is to be found (this again in a topological sense). Unconscious and conscious processes are likewise field processes, but the conscious processes are in some, not merely accessory or accidental respect different from the unconscious ones. Koffka emphasizes this as he continues, "But if we accept our conclusion, consciousness can no longer be regarded as a mere epiphenomenon, a mere luxury, which might just as well be absent. For in an aspect which we do not know, these processes would be different, were they not accompanied by consciousness."

¹¹ Metzger, Wolfgang: *Psychologie*. Dresden: Steinkopf, 1941. P. 232.

¹² Idem, p. 122.

¹³ Loc. cit., p. 65.

III. THE CONSCIOUS AND THE UNCONSCIOUS: THE REGIONS

After it once has been established that psychologists can and often do think of consciousness and unconsciousness as qualities inherent in certain substrata, typical of certain contents, or conditioned by certain functional relations within the psyche, the concept of topological regions distinguished by these qualities and by none other follows very nearly as a matter of course. Such regions would require no separate consideration were it not for the fact that very often from the assignment of a psychic content or event to one region or the other further conclusions concerning it are drawn. Other properties than the one originally used to define it are then attributed to a region or its contents, what was introduced as a region is treated as a system, or — still more confusing — one part of it is fitted out with systemic properties, but the same designation is used for the part and the whole. A suggestion of the confusion that arises was conveyed in the quotation from Freud, and passages yet to be quoted demonstrate that he was not unaware of it himself. It is the purpose of this chapter, then, not only to show that the distinction between region and system is called for by the theories and in the utterances of the authors under consideration, but that the failure to follow it through consistently leads to difficulties and contradictions that we believe it possible to avoid. We shall be content here to see that a difference between region and system is implicitly or explicitly assumed, while the characteristics of the respective systems will occupy us in the next chapter.

1. *In Psychoanalysis*

The occurrence of processes of totally different natures, of which some are typical of directed conscious thought, others of an irrational system, within the same region has been noted pointedly by Freud.¹ "On the one hand we have made the assumption", he writes, "that the dream thoughts arise through wholly normal mental activity, and on the other hand we have discovered a series of wholly abnormal thought processes among the dream thoughts and extending thence to the dream

¹ Freud, Sigmund: *Die Traumdeutung. Gesammelte Schriften*. London: Imago, 1942. Vol. II—III, p. 597. Referred to hereafter as "Traumdeutung".

contents, which we then repeat in the interpretation of dreams.... We have seen that the dream replaces a number of thoughts derived from our daily life and altogether logically composed. We therefore cannot doubt that these thoughts come from our normal mental life. All the properties that we esteem in our trains of thought, that characterize them as complicated performances of a high order, we find again in the dream thoughts. We are not compelled to assume, however, that this work of thinking was performed during sleep,.... These thoughts rather can come very well from the day, can have been carried on, unnoticed by your conscious (*Bewusstsein*), from the moment of their impingement and have been present in their finished form at the moment of going to sleep. If we are to conclude anything from this fact, it is at most the *proof, that the most complicated mental performances are possible without the help of consciousness,....*". In one region, as we see, that of the conscious (not of the unconscious, as we might be tempted to say incautiously, for the dream is present consciously to the dreamer when he dreams it), two distinct kinds of processes are represented, such as are wont to be attributed respectively to the conscious mind and to the unconscious mind. A like discrepancy in the character of processes taking place in the unconscious is recognized in the previously quoted essay "The Unconscious",² in as much as "we find that a part of these latent [i.e. unconscious] processes possess characteristics and properties that appear strange, even incredible to us and run directly counter to the familiar properties of the conscious mind." The emphasis is on the words "a part". The same fact, and the terminological ambiguity to which it leads, is remarked upon once more.³ "Before going further, we will note the important but troublesome fact that unconsciousness is only one characteristic of the psychic, which does not suffice at all for the description thereof. There are mental acts of very different degrees of dignity that yet agree in character in that they are all unconscious. The unconscious includes on the one hand acts that are merely latent, temporarily unconscious, but otherwise different in nothing from the conscious ones, and on the other hand processes such as the repressed ones, which, if they

² Freud, S.: "Das Unbewusste", p. 269.

³ Freud, S.: "Das Unbewusste", p. 270-1.

became conscious, would stick out from the other conscious ones in the most striking manner. It would make an end of all misunderstandings if from now on in the description of the various psychic acts we should disregard wholly whether they are unconscious or not and should classify them and bring them into relation with each other only according to their relations to the drives and goals, according to their composition and their belonging to the respectively superordinated psychic systems. This is impracticable however on various grounds, and thus we cannot escape the ambiguity of using the words conscious and unconscious now in a descriptive, now in a systemic sense, in which they then signify belonging to certain systems and endowment with certain properties." Still in the same essay Freud comes very close to the discrimination we have attempted:⁴ "The ground for all these difficulties is to be sought in the fact that consciousness (*Bewusstheit*), the only characteristic of the psychic processes immediately given to us, is in no way suitable for drawing systemic distinctions. Apart from the fact that the conscious (*das Bewusstsein*) is not always conscious, but at times also latent, observation has shown that much that shares the properties of the system *Vbw* (= *Vorbewusst*, the preconscious) does not become conscious, and we have been compelled to learn that the process of becoming conscious is limited by certain directions of its attention. Consciousness (*das Bewusstsein*) thus stands in no simple relation either to the systems or to repression." Here the distinction is suggested, but not consequently drawn. The difficulties mentioned are solved, not altogether satisfactorily, by increased emphasis on a decidedly ambiguous third member, the preconscious, which, serving two masters at once, takes on the colors and properties now of the one, now of the other. An important step nevertheless has been taken, and a problem recognized that will give much food for thought.

Later writers of the psychoanalytic school have not failed to notice that fundamentally unlike processes may be now conscious, now unconscious, while in both regions like processes are to be found. Brun⁵ notes that, "The 'thinking' of the early

⁴ Idem, p. 291.

⁵ Brun, Rudolf: *Allgemeine Neurosenlehre*. 2 ed. Basel: Benno Schwabe, 1946. P. 288. Italics in the original.

infantile stage of development has now a wholly different character from the logical thinking of the adult. It is an *archaic thinking* such as we also find to a great extent among primitive human races, where it goes on in the full light of consciousness." And Fenichel⁶ is forced to recognize that "it would be simple if ego and conscious, id and unconscious could be co-ordinated. But unfortunately things are more complicated. That which takes place in consciousness consists of....perceptions and impulses.... However, not all impulses and perceptions are conscious."

Turning to Bleuler, we find the concept of the region with its single distinguishing feature more or less explicit:⁷ "When we speak of *unconscious psychic functions* (comprised under the heading of 'the unconscious [*das Unbewusste*]'), then we mean the functions of perception, reflection, affective impulses, action, to which the conscious quality is lacking, *but which in all other respects are like the conscious processes.*" Not only are the conscious and the unconscious processes in themselves alike, but they are not even strictly distinguished from each other by the presence or absence of that functional relation which, according to Bleuler, is the condition of consciousness: the relation to the ego. Thus on p. 42 of the same book he raises the question whether the unconscious be indeed unconscious in a strict sense, or whether "the functions and complexes independent of the ego do not possess a kind of consciousness, which however has nothing to do with the ego's consciousness", and affirms the possibility of this here and again on the following page with the words, "Large split-off portions of the psyche thus possibly may have a consciousness that corresponds in some measure to that of the conscious ego, and which later may be recognized as such." The exception becomes still more striking on p. 54, where he compares the two sets of conditions of consciousness with each other: "In an earlier chapter we have deduced consciousness (*Bewusstsein*) from memory; the function of one moment perceives that of another. In this section we derived consciousness from the association of a central nervous process with the ego. That is no contradiction. In the first case we had to do with *consciousness in general*, in however element-

⁶ Fenichel, p. 16.

⁷ *Naturgeschichte der Seele*, p. 37, fn. 1. Italics in the original.

ary a form one may conceive it. In the second case a process becomes conscious to a complicated ego, which is itself complicated and connected with ideas" (*italics ours*). It is thus clear that the two sets of conditions are not equivalent, their systems not congruent, and that a "consciousness in general", a conscious *region*, remains over, with which the ego has no direct concern.

The distinction between quality and region is also to be found in Bleuler.⁸ "If we designate with the word conscious (*Bewusstsein*) the content, the coherent complex of psychic functions, then we have seen that their coherence can be interrupted in various ways. If we designate with it only conscious quality, then the concept of unity no longer comes into consideration," i.e. from a systemic viewpoint, whereas it may very well from a topological one.

2. In Analytical Psychology

Again relevant utterances of Jung to this problem are few. In his discussion "Concerning the Two Kinds of Thinking"⁹ he says: "While directed thinking is a conscious phenomenon throughout, the same cannot be asserted of phantastic thinking. Doubtless, a great part of it still falls entirely in the realm of the conscious, but, at least, just as much goes along in half shadows, and generally an undetermined amount in the unconscious; and this can, therefore, be disclosed only indirectly.... The products of this phantastic thinking with which the conscious mind has to do directly are, first, waking dreams, or daydreams,.... then the dreams which offer to the conscious, at first, a mysterious exterior, and win meaning only through the indirectly inferred unconscious contents. Lastly, there is a so-called wholly unconscious phantasy system in the split-off complex, which exhibits

⁸ *Naturgeschichte der Seele*, p. 65.

⁹ Jung, C. G.: *Psychology of the Unconscious*. Translated by Beatrice M. Hinkle. New Edition. New York: Moffat, Yard. 1921. Chap. I, p. 19. Jung writes in the original, "Die das Bewusstsein direkt beschäftigenden Produkte des phantastischen Denkens", which Hinkle translates as, "The products of this phantastic thinking arising directly from the consciousness". As this gives a false sense (nothing is said in the original about the products *arising* from the conscious), we have altered the translator's rendering in the quotation above.

a pronounced tendency towards the production of a dissociated personality." Again,¹⁰ "There is hardly an unconscious complex that has not at some time existed as a phantasy in the conscious." It is evident that in these passages the assumption is made that the irrational complex or phantasy has retained its structure in both regions and has differed only in the presence or absence of the conscious quality, in so far as it has not been subjected to a process of analysis and interpretation by the conscious mind. The same assumption is implicit in another place:¹¹ "There are many people that are only partially conscious. Even among absolutely civilized Europeans there is an inordinately large number of abnormally unconscious persons, who pass a large part of their life in an unconscious state. They know what happens to them, but they do not know what they are doing or saying. They can form no conception of the import of their actions." Here consciousness as a quality attaches to the actions of such persons ("they know what is happening to them"), but, although these actions lie in the conscious, the unawareness of their import stamps them as members of a different system from the conscious mind.

3. *In Gestalt Psychology*

At the very outset we find it impossible to carry out our plan as we had intended, for the Gestalt psychologists' reduction of consciousness and unconsciousness to wholly undefineable qualities on the one hand and their treatment of the entire psyche as one field, as a system with any number of varying subsystems on the other, to any one of which consciousness may or may not pertain, has made the distinction we have drawn irrelevant for their investigations, as long as they have remained unconcerned with the special dynamics of unconscious phenomena and have not yet turned their attention to the problems of depth psychology. A passing reference thereto is indeed made by Koffka¹² when he writes: "We know from the investigations

¹⁰ Ibid., p. 11, fn. 15.

¹¹ Jung, C. G.: *Psychologische Betrachtungen*. Collected and edited by Dr. J. Jacobi. Zürich: Rascher, 1945. Pp. 37-38.

¹² Koffka, Kurt: "On the Structure of the Unconscious". *The Unconscious: A Symposium*. Ed. by E. S. Dummer. New York: Knopf, 1929. P. 62.

of the various schools of psychoanalysts a good deal about the morbid effects which such stress-systems produce when the stresses are held in abeyance. Concepts like those of the different individual 'complexes' and the conflicts between them find their places also in our system. For our system shares with the psychoanalytic theories one fundamental assumption, the justification of which has been so clearly demonstrated by Dr. Lewin: the unconscious, and with it the total personality, is structured, in the same sense in which our visual field is structured. In either case we do not find a homogeneous unity but an articulation into autonomous sub-units with different and varying degrees of mutual isolation. These sub-units of the unconscious are those stressed systems which we have been at so much pains to discuss." Here the "stresses held in abeyance" and the character of the individual, conflicting complexes lend the unconscious mind its typical features.

If we find few other passages in Gestalt literature in which the distinction is applied to the questions here treated, yet the possibility of a distinction between region and system in general is implicit everywhere in Gestalt theory and furnishes the very basis of Lewin's *Topological Psychology*, to which the reader may be referred. We shall see, when we come to discuss the dynamic interrelations of the two systems, that it can be introduced into depth psychology without the slightest difficulty, while a treatment of it at this point would lead to no new results.

IV. THE CONSCIOUS MIND AND THE UNCONSCIOUS MIND: THE SYSTEMS

Since psychology has begun to take notice of the alogical factors in the human psyche, an enormous literature has accumulated devoted to the characterization in particular of the unconscious mind. We shall make no attempt to review it in detail, nor shall we inquire at all into the observations on which it is based, but shall content ourselves with a few brief summarizing passages from representative authors in the main, quoting from them more extensively only where points of importance for future discussion are to be emphasized.

1. In Psychoanalysis

Freud's conception of a primary and secondary ψ -System is set forth in his *Interpretation of Dreams*. The function of the primary system is to bring all psychic impulses arising from within or without to discharge in the form of motor reactions, to prevent an accumulation of energy charges and thus of unpleasurable tension. It is dominated wholly by the pleasure principle. The tendency to unrestricted discharge collides with the demands of reality and makes necessary an inhibition and re-direction of the impulses striving blindly toward immediate abreaction, in order to prevent painful consequences. This need is supplied by the secondary system, acting under the reality principle. Freud goes on to say:¹ "That psychic process which only the first system admits I shall now call the *primary process*; that which results as a consequence of inhibition through the second the *secondary process*.... The primary process strives for the discharge of excitation in order to create a *perceptual identity* with the quantity of excitation thus obtained; the secondary process has abandoned this intention and formed another in its place, that of creating a *conceptual identity*." The consequences of this perceptual and to a large degree unconscious identification are shown in the following:² "The most surprising characteristic of the unconscious (repressed) processes, to which every investigator accustoms himself only with the greatest difficulty, follows from the fact that the test of reality does not count for them, that the reality of mere imagination is set equal to external reality, the wish to the fulfillment, the event, as follows immediately from the predominance of the old pleasure principle." Here the unconscious processes are more or less identified with the primary ones, and we learn soon afterward³ that "there is in this system no negation, no doubt, no degree of certainty. All this is first introduced through the work of the censor between *Ubw* [the unconscious mind] and *Vbw* [the preconscious].... In *Ubw* there are only

¹ *Traumdeutung*, p. 607.

² Freud, Sigmund: "Formulierungen über die zwei Prinzipien des psychischen Geschehens". First published in the *Jahrbuch für Psychoanalytische und Psychopathologische Forschungen*, Vol. III (1911). Quoted from *Gesammelte Schriften*. London: Imago, 1943. Vol. VIII, p. 237.

³ "Das Unbewusste", p. 285.

more or less strongly charged contents. A far greater motility of the charges prevails. Through the process of displacement one idea can give another the whole amount of its charge, through that of condensation it can take over the whole charge of various others itself. I have proposed to regard these two processes as signs of the so-called psychic primary process. In the system *Vbw* the secondary process predominates:.. In summary absence of contradictions, primary process (motility of the charges), timelessness, and replacement of external by psychic reality are the characteristics we can expect to find in the processes belonging to the system *Ubw*." We see, though, that not all strictly unconscious processes are endowed with these qualities; those of the preconscious are excepted; the region of the unconscious and the system of the unconscious mind are not co-extensive.

Freud's primary process is conceived as primary in time, which leads to the designation of it in many places as "archaic thinking". Such thinking is characterized by Brun⁴ (following Levy-Bruhl, Frazer, Roheim, and Windhuis) as "symbolic-sexual, identifying, animistic-personifying, participative, and collective". Fenichel⁵ states the difference between the two modes of "thought" (in reality: of psychic functioning in general) as follows (we recall that he has referred to the fact that perceptions can be unconscious as well as conscious): "The differences between the perceptions of infants and of adults have the consequence that they experience the world differently.... Objects are not necessarily sharply distinguished from one another or from the ego or from parts of it. The first images are large in extent, all enveloping and inexact. They do not consist of elements that are later put together, but rather of units, wholes, which only later are recognized as containing different elements. Not only are perceptions and motility inseparable, but also the perceptions of many sense organs overlap.... The world is perceived according to the instincts as a possible source of satisfaction or a possible threat; instinctual wishes and fears falsify reality. A more objective perception presupposes a certain psychological distance of the perceiving ego from the data of perception....".

⁴ Loc. cit., p. 288.

⁵ Loc. cit., p. 38—39.

Again,⁶ "Another strange characteristic of archaic thinking is represented by symbolism.... Symbolic thinking is vague, directed by the primary process."⁷

Bleuler's description of what he has named autistic or dereistic thinking⁸ is so similar to the foregoing that we shall quote only a few words, emphasizing however some additional points:⁹ "There is a kind of thinking that is independent of logical rules and is directed in their stead by affective needs.... Of course it does not scorn to use normal material and normal trains of thought along with the abnormal.... Autistic thinking can be conscious or unconscious, just like logical thinking.... Autistic thinking is not a primitive form of thought. It could only be developed after thinking with mere sensory images predominated strongly over the immediate psychic reaction to actual external situations." Since autistic thinking according to the above is neither temporally primary nor exclusively unconscious, it may well be asked whether it deserves to be considered here, where we are seeking characterizations of the conscious mind and the unconscious mind. Bleuler himself gives the answer:¹⁰ "Half-conscious thought is often inadequate and superficial, and wholly unconscious, as it often becomes manifest in states of sickness, reveals itself usually as an inferior, indeed often as a really illogical, dereistic kind of thought." It did not escape the acute observation of the pioneer in the field of schizophrenia that the common identification of alogical with unconscious psychic processes and the reverse held only in a limited number of cases and obscured the real issue. "The whole controversy in this question", he goes on to say, "rests upon an incorrect view. Introspection, knowing oneself, is not identical with the conscious function. There is conscious and unconscious

⁶ Fenichel, loc. cit., p. 48.

⁷ Under "symbol" we can understand here both a sign, i.e. a mere token for something else, and a symbol in the sense defined by Jung as "the best possible formulation of a relatively unknown thing which cannot conceivably.... be more clearly or characteristically represented" (*Psychological Types*, p. 601).

⁸ Bleuler, Eugen: "Das autistische Denken". *Jahrbuch für Psychoanalytische und Psychopathologische Forschungen*, Vol. IV, pp. 1—39. The same: *Naturgeschichte der Seele*, Part III, Chap. C, pp. 191—199 ("Das dereierende Denken"). The same: *Lehrbuch der Psychiatrie*, 6th ed. (1937), pp. 24—26.

⁹ "Das autistische Denken", pp. 37—39.

¹⁰ *Naturgeschichte der Seele*, p. 71.

inner knowledge, just as there is conscious and unconscious knowledge of the outer world." Introspection, inner knowledge, is commonly used more or less synonymously with consciousness, but in reality only a part of it is conscious. Bleuler illustrates this with the example of a difficult medical diagnosis, in which a multitude of imponderable and scarcely objectifiable factors are weighed together in an instant and determine the relative importance attached to the objectively defineable symptoms that are taken consciously into consideration. Only this last stage, the product of previous intense but unconscious occupation with the case, comes into the conscious mind as purposive reflection and decision. The respective shares of the unconscious mind and the conscious mind in knowing the outer world are demonstrated in the example of throwing a ball. Having set ourselves the task of throwing it to hit a certain mark, we bring together and co-ordinate almost wholly unconsciously the innumerable factors of air resistance, wind, stance, weight of the ball, muscle power, and the like in a single unreflective action, while, if we should attempt to calculate how the ball must be thrown, we should come after a complicated and effortful mental process at best to an approximate and much less trustworthy result. Thus in numberless actions of daily life direct but unconscious observation "from within" in Bleuler's sense proves itself far superior to the most intelligent conscious and objective deliberation. In many cases, it is true, observation "from within" becomes autistic because control of it through comparison with objective fact is lacking, and often it precedes unconsciously, but it is an independent category of thinking, inherent in our mental constitution, not to be regarded as a mere systemic quality or property of the unconscious mind. It permits us to grasp and react adequately to infinitely more numerous and complicated relations than would be possible otherwise. Consciousness is a somewhat accidental quality, playing no essential objective role.¹¹

2. In Analytical Psychology

Jung makes it clear that he distinguishes between the conscious mind and the unconscious mind upon other grounds than

¹¹ Details in *Naturgeschichte der Seele*, Part II, Chap. K: "Die Bedeutung des Bewusstseins". Pp. 71-75.

that of mere quality or extension. "Psychological empiricism up to a short time ago was fond, though, of explaining the 'unconscious' — as this word itself shows — in terms of the mere absence of consciousness, as a shadow in terms of the absence of light. Not only all times before us, but also the contemporary exact observation of unconscious processes recognizes that the unconscious mind (*das Unbewusste*) possesses a certain creative autonomy that could never belong to the nature of a mere shadow."¹²

The principal formulations of the structural (as opposed to the dynamic and final) differences between the two systems are to be found in the essay "Concerning the Two Kinds of Thinking" which Jung prefaced to his *Psychology of the Unconscious*. Although written later than Bleuler's "Das autistische Denken", it was published a year earlier and presents some interesting divergences. Jung contrasts "directed thought" on the one hand with dreaming and phantasy on the other. The former is directed toward external objects, corresponds to the "succession of the objectively real things", is given its direction by a super-ordinated or goal concept, and is thought in terms of language. Jung quotes Külpe to the effect that thought is "a kind of inner act of will". The modes of "merely associative" thought or phantasy, best exemplified in dreams, on the other hand are those by analogy, are subjectively deformed and thus infantile. "The first, working for communication with speech elements, is troublesome and exhausting; the latter, on the contrary, goes on without trouble, working spontaneously, so to speak, with reminiscences. The first creates innovations, adaptations, imitates reality and seeks to act upon it. The latter, on the contrary, turns away from reality, sets free subjective wishes, and is, in regard to adaptation, wholly unproductive."¹³ We have already seen that for Jung such merely associative thinking is to a large degree characteristic of the unconscious mind. He goes indeed so far as to exclude directed thought entirely from the latter, as Bleuler expressly does not. Neither does Bleuler regard thinking in words as a necessary condition of

¹² Jung, C. G.: *Psychologie und Religion*. Zürich: Rascher, 1942. This passage is lacking in the original English edition of *Psychology and Religion* (New Haven: Yale University Press, 1938).

¹³ *Psychology of the Unconscious*, p. 11.

directed thought, and thinking in words can in his view very well be autistic. Jung, as we shall see later, derives directed from merely associative thinking in temporal order, whereas for Bleuler autistic thought only becomes possible after objective perception is established.

The subjective, dereistic character of many products of the unconscious mind is emphasized ever and again.¹⁴ "Not the world as we know it speaks out of his [the primitive's] unconscious mind (*aus seinem Unbewussten*), but the unknown world of the psyche, of which we know that it mirrors our empirical world only in part, and that it forms this, for the other part, according to its own psychic premisses. The archetype does not take its origin from physical facts, but rather portrays how the mind experiences the physical fact, in doing which the mind often behaves so autocratically that it denies the tangible reality or asserts things that mock at it." "Divergence from and setting oneself in opposition to instinct creates the conscious mind (*Bewusstsein*). Instinct is nature and intends nature. The conscious mind on the other hand can only intend culture or its denial.... In so far as we are still nature we are unconscious and live in the security of unproblematic instinct. Everything in us that is still nature shrinks from the problem, for its name is doubt, and wherever doubt prevails is insecurity and the possibility of different ways. Here our conscious mind should do what nature has always done for her children, — namely decide surely, without doubt, and without ambiguity."¹⁵ The similarity to Freud's conception is obvious: where immediate satisfaction is jeopardized by the demands of the environment, the conscious mind must intervene; it must realize the problem and reach a decision by means of abstraction and objective appraisal. "Instinct" corresponds here very closely to Bleuler's "inner knowledge", subserving the same purpose of adequate but unreflective reaction. Where it is insufficient, directed thinking must step in.

¹⁴ Jung, C. G.: "On the Psychology of the Child Archetype" in Jung and Kerenyi: *Prolegomena to a Science of Mythology*. Translated by K. W. Bash. London: Kegan Paul (in press).

¹⁵ Jung, C. G.: *Seelenprobleme der Gegenwart*. Zürich: Rascher, 1931. Pp. 249—250.

3. In Gestalt Psychology

In view of the emphasis laid by Gestalt psychology on the unitary field character of the conscious and the unconscious, indeed of its express denial of any distinction between them save in the attribute of consciousness or unconsciousness, it may well seem possible to close this section with a sentence. This would be true if we insisted rigidly upon these attributes as at least accessory determinants of the systems under consideration. If we disregard them for the moment though entirely, we shall see that Gestalt psychology without any primary reference to consciousness or unconsciousness has established categories of the greatest importance for depth psychology, whose hitherto insufficiently recognized correspondence with categories of the latter, which we have just examined in the preceding sections, is striking.

The categories we refer to are those of concrete and abstract behavior, introduced into psychopathology nearly thirty years ago by Goldstein and Gelb¹⁶ in their studies of patients with cerebral lesions. As we shall have occasion to refer to them many times, and as they have become less familiar on the whole than those of the analytic schools, it seems advisable to quote somewhat extensively from Goldstein's most recent and concise presentation of them.¹⁷

"These attitudes, or behaviors", Goldstein says, "are not acquired mental sets or habits of an individual, nor do they represent specific aptitudes such as memory or attention. They are, rather, capacity levels of the total personality, each furnishing the basis for all performances on a certain plane of reference to the outer world situation.

"The concrete attitude is realistic. In this attitude, we are given over and bound to the immediate experience of the given thing or situation in its particular uniqueness. Our thinking and acting are directed by the immediate claims made by one particular aspect of the object or situation in the environment.

¹⁶ Gelb, A., and Goldstein, K.: *Psychologische Analysen hirnpathologischer Fälle*. Leipzig: Barth, 1920.

¹⁷ Goldstein, K.: "Methodological Approach to the Study of Schizophrenic Thought Disorder". *Language and Thought in Schizophrenia*. Collected Papers, ed. by J. S. Kasanin. Berkeley: University of California Press, 1946. Pp. 18—20. (Quoted in the following as „Methodological Approach“).

"In the abstract attitude, we transgress the immediately given specific aspect or sense impression; we abstract from particular properties. We are oriented in our action by a more conceptual viewpoint, be it a category, a class, or a general meaning under which the particular object before us falls. We detach ourselves from the given impression, and the individual thing represents to us an accidental sample or representative of a category. Hence this attitude is also called the categorical or conceptual attitude. The abstract attitude is basic for the ability:

- "1. To assume a mental set voluntarily.
- "2. To shift voluntarily from one aspect of the situation to another.
- "3. To keep in mind simultaneously various aspects.
- "4. To grasp the essential of a given whole; to break up a given whole into parts and to isolate them voluntarily.
- "5. To generalize; to abstract common properties, to plan ahead ideationally; to assume an attitude toward the 'mere possible', and to think or perform symbolically.
- "6. To detach our ego from the outer world.

"The abstract behavior is the more active; the concrete, the more passive.

"There are various degrees of abstract behavior corresponding to the degree of complexity which the performance in question involves. For instance, an especially high degree of abstract behavior is requisite for the conscious and volitional act of directing any performance whatsoever and accounting for it to oneself or to others. A lesser degree of abstract behavior is required for conceptual behavior if unaccompanied by awareness of one's own doing. Symbolic or metaphoric thinking and behavior in everyday life may be considered as a special instance of the latter behavior."¹⁸

"This gradation applies also to concrete behavior. The most concrete way of dealing with situations or things is to react to but one of their properties, which alone is experienced; A less concrete approach is indicated when the person is embracing in his scope the total concrete configuration of an object or situation and is not determined in his response by one particularity of it alone.

¹⁸ "Symbolic" is used here, of course, in the sense of manipulation by means of signs, not in the sense of the Jungian symbol (cf. fn. 7, p. 23).

"The normal individual combines both attitudes and is capable of shifting from one to the other at will according to the demands of the situation. Some tasks can be performed only by virtue of the abstract attitude; for others, the concrete attitude is sufficient."

The similarity between Goldstein's concrete behavior on the one hand and Freud's primary process, Bleuler's autistic thinking, and Jung's associative thinking on the other is apparent immediately. Whereas, though, the latter three categories emphasize the inadequacy of such forms of reaction for adjustment in the outer world, which inadequacy has made them a striking characteristic of neurosis and thus an object of psychopathology, we find in Goldstein the recognition that, while indeed some tasks are impossible without the abstract attitude, "for others, the concrete attitude is sufficient." In fact, the concrete attitude is that which we daily adopt and which serves us well in a thousand situations. It is essentially an immediate reaction to the demand-character (*Aufforderungscharakter*) or, in Lewin's term, the valence of things. An apple is something to be eaten, and we bite into it without more ado; a level surface without obstructions is an invitation to locomotion, and we walk across it; a stick is something to be taken into the hand and used to push or strike. Apparently coherent masses of material are treated as wholes; physiognomic characters are reacted to despite their indefinability, or without any attempt at definition, and guide us with a fair degree of reliability in our reactions to persons; daily recurring situations in their manifold variations require typical responses, which are forthcoming without further consideration — often even then when an exceptional situation demands a wholly new response. The concrete attitude is "nature" in Jung's sense; it decides "surely, without doubt, and without ambiguity" in a vast number of cases, but also occasionally falsely, as "nature" often does when confronted with the problems of "culture". It is too "inner knowledge" as Bleuler means it and may be, like the latter, conscious or unconscious.¹⁹ Goldstein, it is true, writes now and

¹⁹ In former days, when psychology was wont to be defined as the "science of consciousness", much fruitless discussion was wasted on this point. The early depth psychologists pointed to instances of concrete, i.e. unreflective behavior as manifestations of the "unconscious", while more

then as if the concrete attitude were typically or exclusively the unconscious, the abstract attitude the conscious one. Thus he says the concrete attitude "does not imply conscious activity in the sense of reasoning, awareness, or a self-account of one's doing."²⁰ "A great part of our daily activities runs off on a concrete basis which consists either of an unlearned experiential unreflectiveness or of acquired performances which do not need conscious, volitional activity. Abstract behavior as an indispensable factor is brought into play whenever the situation cannot be mastered without the subject's detaching his ego from the situation. This conscious volition initiates the required performance or its shifting and if necessary controls the further course."²¹ We have seen already that according to Goldstein the abstract attitude is necessary for various volitional acts such as assuming a mental set, shifting voluntarily from one aspect of the situation to another, analysis, generalization, planning ahead, directing a performance and accounting for it to oneself or others, and the like. Volition is everywhere assumed to be conscious. The difficulty disappears as soon as we recognize these terms to be purely descriptive, conditioned by the introspective evidence of the subjects used in the experiments, to which in Goldstein's and Scheerer's monograph not seldom an appeal is made. Conscious volition or will is then no mysterious agency of abstract behavior, but the conscious experience of the conflict between various determinants of behavior and of its resolution ("decision"). This experience is a rather typical but by no means necessary accompaniment of abstract behavior. We shall see later why. "Conscious volition initiates" nothing by itself. A more suitable form of expression would be: "The required performance is initiated with con-

academically minded psychologists replied scornfully that in many such cases the subject obviously was awake and conscious while so performing. It is clear now that such behavior belongs to the region of the conscious, but to the system of the unconscious mind.

²⁰ Goldstein, K., and Scheerer, M.: *Abstract and Concrete Behavior, An Experimental Study with Special Tests. Psychological Monographs* Vol. 53, No. 2. Whole No. 239. Evanston, Illinois: American Psychological Association, 1941. P. 2. A comprehensive presentation of the subject, to which the reader may be referred.

²¹ Goldstein and Scheerer: *Abstract and Concrete Behavior*, p. 29. Referred to in the following only by the names of the authors.

scious volition" i.e. volition is a preliminary phase in which the conscious interplay of behavioral determinants takes place, and from which behavior follows.

Although Goldstein in the passage quoted above restricted his two attitudes or behaviors to being the "basis for all performances on a certain plane of reference to the outer world situation", this limitation of their application to the outer world is not upheld elsewhere. In a very similar passage from 1941²² we read simply that they are "the basis for all performances pertaining to a specific plane of activity", and in the essay first quoted he subsequently removes his restrictions with the words, "I prefer to speak of a change in the total behavior and to consider the impairment in thinking a special expression of the latter."²³ It is thus evident that we may behave abstractly or concretely in overt action or in thought, in regard to percepts or to thought-images. Concrete behavior in regard to thought-images is what we already have learned to know as autistic or dereistic thinking. Had Bleuler not so emphasized the word "thinking", he would have been under no necessity to affirm that it was not a primitive form of thought. Where such behavior is referred to thought-images, it obviously depends on the pre-existence of these images, but nothing requires it in principle to be referred exclusively to them. Jung, too, speaks of "associative thinking", but also of "dreaming or phantasy", which can take their rise equally well from thought-images or percepts. Therefore he was able to recognize that such forms of thinking in truth are more primitive, as child psychology and ethnology have abundantly confirmed. On the other hand, he explicitly identified directed thinking with conscious thinking, as Bleuler did not, — a tendency that we have discovered in Goldstein also. Now, what does directed thinking really mean?

The term is decidedly ambiguous according as it is used to signify "having a direction toward something" or "being given a direction by something". Jung, who has insisted untirelessly on the finalistic character of all psychological processes, probably would be the last to deny that unconscious psychic activity can be directed in the former sense. One only needs to observe the

²² Goldstein and Scheerer, p. 1.

²³ Goldstein: "Methodological Approach", p. 21—22.

tenacity with which one motive is held fast and followed through in a dream series up to the stage of development necessary for the given individual at the given time in order to be convinced of this. If we take "directed" in its second sense, by what, then, is "thought" (i.e. psychic activity in general) given its direction? In terms of an introspective faculty psychology we could answer: by the will, but a scientific psychology can afford no place to any arbitrary imp that decides now so, now so, and is subject to no law. If we define the will as above when we were discussing volitional behavior, then volitional behavior exhibits no characteristics that distinguish it in principle from other types of behavior with multiple conflicting determinants except, by definition, the quality of consciousness attaching at least to its initial phase. But multiple conflicting determinants have been proven so often by the analysis of behavior and of dreams to exist at the basis of involuntary acts that there can be no question but that they are to be found in the unconscious as well as in the conscious. Freud, it is true, excludes any possibility of conflict or negation from his primary system, only to admit them again in the preconscious. The preconscious belongs however in our terminology to the unconscious, and this distinction, not that between the systems, is decisive for our present question. Unless we admit the will as an arbitrary instance, it is meaningless to ascribe the directedness of psychic activity to its agency, and the two senses of "directed" that we have discriminated above fall then into one. But Jung gives other indications of what he means by "directed thought". It is directed toward external objects, corresponds to their succession, and is determined by a superordinated or goal concept. None of these criteria, however, requires that it be conscious. Unconscious thought often attends very well to external objects, as when we realize only subsequently that we have seen or heard this or that at a former time; it corresponds not seldom precisely to their succession, as when something in us counts — correctly — the strokes of a clock that we do not hear and announces the sum to us toward the end of the series; while the superordinated or goal concept can be demonstrated in many dream series, but often can be made conscious to the patient only after a protracted analysis. We grant freely that these three criteria are frequent, typical characteristics of conscious, volitional, or

directed thought, but not that they are *necessary* qualities of the same.

Jung further asserts that directed, conscious thought is always thinking in terms of language, with which Bleuler is at variance. Here the appeal to experience is possible. It has happened to nearly everyone at some time or another that the solution of a problem with which he is busying himself intensively suddenly has appeared to him, but that he has the utmost difficulty thereafter to clothe it in words or formulae. In such cases thought leaves the clumsy vehicle of language far behind, — thought of whose directedness there cannot be the slightest question. Jung seems here to identify conceptual thinking with thought in words and to overlook for the moment the fact that most words have, beside their clear conceptual content, innumerable connotations and also personal associations, to which it is possible to react in an entirely concrete manner. If thought in words were of itself necessarily conscious, we should be at a loss to understand how Jung's own word association experiment could serve so excellently as an indicator of unconscious complexes. We conclude, then, that directed thought in Jung's sense, which has so much in common with Goldstein's abstract attitude, is by no means necessarily conscious, but constitutes a specific system of psychic activity that can be found, just as the latter, in the conscious and the unconscious alike.

4. *Recapitulation*

In the preceding pages we have endeavored to show that the threefold meaning of "consciousness" and "the unconscious" as quality, as topological region, and as system of psychic processes is present in the leading schools of depth psychology and in Gestalt psychology as well. In the course of our analyses of various descriptive accounts of "consciousness" and "the unconscious" we have not only discovered a far-reaching agreement among the properties that different schools ascribe to the members of their respective pairs of systems, but we have also seen that the qualities of consciousness and unconsciousness in no case are necessary or sufficient conditions or even regular attributes of the systems designated provisionally as the conscious mind and the unconscious mind. These design-

ations are a matter of familiarity and convenience, come into nearly universal usage because as a matter of fact the systemic properties of the unconscious mind do present themselves most strikingly to our notice as the results of unconscious processes and conversely. They have led to no little confusion of thinking, as attempts are made constantly to account for the two qualities by means of the two systems and *vice versa*. As the regions of the conscious and the unconscious are demonstrably not co-extensive with the systems of the conscious mind and the unconscious mind, such attempts are doomed to failure. It has been our aim, therefore, to set forth this incongruity in some detail in order to clear the ground for a fresh attempt at determining the nature of consciousness and unconsciousness.

In considering the two basic attitudes or types of reaction that Gestalt psychology differentiates, we have become aware of their far-reaching parallelism with the paired systems of depth psychology and have regarded it as a confirmation of the views developed above that they were set up with at most a secondary and unessential reference to the concepts of consciousness and unconsciousness. The parallelism between the results of the two schools, arrived at independently and by means of wholly different methods, goes much further still, as I have attempted to show in another place.²⁴ We regard this as of importance not only for the theoretical unification that it brings, but still more because it opens the way through the experimental methods of Gestalt psychology to a verification and extension of analytical theories in a manner acceptable not only to the analytical clinician, but also to the experimental biologist and psychologist. In the present state of our knowledge, it is too early to say whether the concepts of the concrete and abstract attitudes are wholly adequate to cover the known properties of the unconscious mind and the conscious mind. There can be little question but that they coincide to a great degree — how great, can only be determined for the moment by an exhaustive analysis of a large clinical material, which is beyond the scope of this article. The coincidence is, however, so considerable that the concepts of Gestalt psychology may well

²⁴ Bash, K. W.: "Gestalt, Symbol und Archetypus. Ueber einige Beziehungen zwischen Gestalt- und Tiefenpsychologie". *Schweizerische Zeitschrift für Psychologie* VI, 2 (1946), 127—138.

prove most fruitful in further work in the psychology and psychopathology of "the unconscious". Since they describe at any event more accurately the true characteristics of the two basic systems, we shall in the following often let them replace the rather misleading provisional expressions employed hitherto, the "conscious mind" and the "unconscious mind", and shall speak not only of an abstract or concrete attitude, but also respectively of an abstract or concrete system.

We turn now from the consideration of the merely descriptive properties of "consciousness" and "the unconscious" to that of the conditions determining them, their origins and functions.

V. THEORIES AND CONDITIONS OF CONSCIOUSNESS

In this chapter we shall be concerned with the formal conditions of consciousness, touching upon the bitterly controversial questions between the several schools of depth psychology as to its *causae finales*, the grounds of its existence, and the aims of its functioning only in so far as is necessary for the understanding of the former. Concerning these, a certain similarity of opinion is noticeable in many respects, so that we can consider the views of various schools in part together.

1. In William James

Before we begin with the psychoanalytic theories as hitherto, it will be instructive to recall briefly the theory of consciousness held by one who was in many respects a forerunner of both depth and Gestalt psychology — William James.¹ In marked contrast to the "atomistic" psychologies of his time, James taught that "consciousness" was no mosaic of mental elements, but a continuously flowing stream, in which one thought merged imperceptibly through an aura of premonition on the one hand and of persistent influence on the other into the next and gave itself to be recognized as this or that thought at the moment of its greatest intensity and clearest delineation. The continuity of the stream of consciousness is assured by means of the ever present reference of contemporary to former,

¹ James, William: *The Principles of Psychology*. New York: Henry Holt, 1896. Vol. I, Chap. VIII—X. Quoted in the following only by the name of the author.

different states.² Furthermore, "The mind is at every stage a theatre of simultaneous possibilities. Consciousness consists in the comparison of these with each other, the selection of some, and the suppression of the rest by the reinforcing and inhibiting agency of attention".³ Such comparison is possible because no simple feeling⁴ as such ever returns. New feelings always differ from the old in that they are "*cognizant and appropriative of the old, whereas the old were always cognizant and appropriative of something else*".⁵ The comparison over time of such feelings as possess a peculiar, characteristic warmth and intimacy and are accompanied by a constant undertone of bodily sensations constitutes our sense of personal identity. "The sense of our personal identity, then, is exactly like any one of our other perceptions of sameness among phenomena. It is a conclusion grounded either on the resemblance in a fundamental respect, or on the continuity before the mind, of the phenomena compared".⁶

James's continuous, indivisible stream of consciousness (he postulated no "unconscious", but put with foresight and left open the question of its existence) bears an unmistakeable resemblance to the field theory of Gestalt psychology. Implicitly, the sense of personal identity, the consciousness of self, is based upon memory, which makes possible the comparison of a past thought represented in memory with a present one distinct from the former, and the recognition of their similarity. Therein James anticipates Bleuler, as we shall see. He anticipates also, and again without referring to the qualities of consciousness or unconsciousness, the distinction between the concrete and abstract attitudes made by Goldstein when he writes in a noted passage:⁷ "*There are two kinds of knowledge broadly and practically distinguishable: we may call them respectively knowledge of acquaintance and knowledge-*

² James, p. 240—242.

³ Idem, p. 288.

⁴ James uses "feeling" and "thought" interchangeably and, as he expressly declares, in a wider sense than customary for "mental states", i. e. psychic contents in general (cf. *Principles of Psychology*, Vol. I, p. 186).

⁵ James, p. 354. One recalls here Freud's conceptual and perceptual identity (cf. p. 21).

⁶ Idem, p. 334.

⁷ Idem, p. 221—222. Italics in the original.

about.... I am acquainted with many people and things, which I know very little about, except their presence in the places where I have met them. I know the color blue when I see it, and the flavor of a pear when I taste it; I know an inch when I move my finger through it; a second of time when I feel it pass; an effort of attention when I make it; the difference between two things when I notice it; but *about* the inner nature of these facts or what makes them what they are, I can say nothing at all. I cannot impart acquaintance with them to anyone who has not already made it himself.... All the elementary qualities of the world, its highest genera, the simple qualities of matter and mind, together with the kinds of relation that subsist between them, must either not be known at all, or known in this dumb way of acquaintance without *knowledge-about*.... In general the less we analyze a thing, and the fewer of its relations we perceive, the less we know about it and the more our familiarity with it is of the acquaintance type.... The same thought of a thing may be called knowledge-about it in comparison with a simpler thought, or acquaintance with it in comparison with a thought of it that is more articulate and explicit still." And again, pregnantly stated,⁸ "Knowledge *about* a thing is knowledge of its relations. Acquaintance with it is limitation to the bare impression which it makes." It is clear that we arrive at *knowledge-about* a thing only by virtue of the abstract attitude, whereas *knowledge of acquaintance* compels perforce a reaction to the "mere impression", i.e. concrete behavior.

2. In Psychoanalysis

As many of Freud's views are found reflected, but extended or modified, in Bleuler and Jung, our discussion of them will be brief. As soon as an "unconscious" is postulated the question arises, which James was not yet forced to answer, as to which is prior. Freud's pronouncement is unambiguous:⁹ "The unconscious must be assumed to be.... the general basis of psychic life. The unconscious is the larger circle that includes the smaller of the conscious in itself; everything conscious has a forerunner in the unconscious,.... The unconscious is really

⁸ James, p. 259.

⁹ *Traumdeutung*, p. 617.

the true psychic". It is known, albeit imperfectly, through the agency of the conscious, which constitutes a "sense organ for the perception of psychic qualities".¹⁰ "Becoming conscious is dependent on the turning of a certain psychic function, attention, toward [the respective content]".¹¹ What happens then? "The chain of thought directed to a goal becomes capable under certain conditions of drawing the attention of the conscious mind (*des Bewusstseins*) to itself and receives then through its mediation an 'over-charge'".¹² "The system Vbw does not only block the access to the conscious,.... it has the disposition over a mobile energy charge, one portion of which is already familiar to us as attention".¹³ We meet attention once more as a condition of consciousness as in James, but are led a step further by its definition not as a faculty or function in itself, but as a disposer of available energy charges.

Contents are blocked from the conscious either because the simultaneous presence therein of the representations of incompatible drives leads to displeasure, or because a later derivative of a drive whose representations have been repressed for the above reason collides with a defense mechanism. Our question must be: How does this mechanism work? Freud discusses it at length in his essay "The Unconscious". A discrimination of contents takes place at the boundary between the unconscious and the pre-conscious by means of the so-called "censor". A content that has passed the censor is admitted into the pre-conscious, which, as we have seen, shares many of the systemic properties of the conscious mind, and can then as a rule become conscious without more trouble as soon as attention is directed to it, i.e. as soon as it receives an additional charge of energy. Here Freud raises the question whether its representation in the conscious is based upon the formation of a new trace or a functional alteration in the old. Contents not passed by the censor nevertheless can remain active in the unconscious and therefore evidently retain their charges. Therefore they must have been met at the critical threshold by a counter-charge in the pre-conscious. In other cases the pre-conscious charge that

¹⁰ Traumdeutung, p. 620.

¹¹ Ibid., p. 598.

¹² Ibid., p. 599.

¹³ Ibid., p. 620.

they already have acquired, and which was suitable for raising their intensity beyond the next threshold into the conscious, may simply be withdrawn, whereupon they relapse into inactivity. This apparently obvious scheme presents a number of difficulties. It is noticeable that the same pre-conscious charge may work now for, now against consciousness. What determines the direction of its effectiveness? One may say, the nature of the contents themselves, or else their incompatibility with the conscious, and is then compelled to assume, as Freud actually does assume, a second censorship at the threshold between the pre-conscious and the conscious. But then it is hard to see why those rejected contents should have passed the *first* censor at all and received a charge from the pre-conscious, whose structure and incompatibilities are by definition at least very similar to those of the conscious mind, or how is it possible for them, being thus surcharged, to recede again into the unconscious from the pre-conscious, as analysis demonstrates that they very frequently do? Finally, if their mere incompatibility with the contents of the conscious be sufficient to prevent them from becoming conscious after they have been surcharged in the pre-conscious, why it is necessary to assume any countercharge at all? We escape these difficulties, it seems to me, only if we assume that charge and countercharge, as the terms themselves imply, represent not the same but *two basically different kinds of charges* capable under appropriate circumstances of annulling each other, instead of merely the "mobile energy charge" that we encountered above.

After developing this dynamic theory of the process of becoming conscious, Freud returns to his earlier question and remarks that on this view the conception of ever-renewed traces in the respective regions is untenable and must give way to that of functional alterations in the same trace.

A further point is of importance for comparison with the theories of Bleuler and Jung. Discussing the question whether the demonstration of autonomous psychic phenomena in one and the same bearer would not lead more properly, as Janet maintained, to the postulate of multiple conscious regions or even multiple conscious minds than to that of the unconscious, Freud says,¹⁴ "In the first place a conscious (*ein Bewusstsein*)

¹⁴ "Das Unbewusste", p. 269.

of which its own bearer knows nothing is something else again than a foreign conscious, and it is questionable whether such a conscious that is lacking in its most essential characteristic is worthy of discussion at all". Furthermore, since the contents of these various hypothetical consciousnesses behave practically independently of one another, one would have to postulate not merely a double conscious, but a whole series. "Finally, we must take into consideration as the weightiest argument that we learn through analytic research that a part of these latent processes possess characteristics and peculiarities that appear strange, even incredible to us and stand in direct contradiction to the properties of the conscious mind as we know them." We shall take the arguments in reverse order. The last is based obviously on the divergent properties of the conscious mind and the unconscious mind and compels us indeed to postulate two different systems or attitudes, about whose consciousness or unconsciousness nothing is said thereby in principle. The assignment of these two latter qualities to them is purely empirical and is far from holding without exception, as has been demonstrated. The conclusion drawn and dismissed as absurd in the second objection becomes admissible again the moment we cease to identify the conscious with the conscious mind and concede that the conscious can comprise a multiplicity of discrete sub-regions — a fact of which we are reminded nightly in dreams. The importance of these latter arguments lies in their connection with the first, which implies a consciousness of self, in other words a felt relation of the conscious content to the ego, as a condition of consciousness at all. Their rejection does not in the least oblige us to accept Janet's alternative view, against which the accumulated mass of empirical evidence tells. The first argument has more consequences, and its basic assumption recurs frequently in other writers. This assumption has been exposed so brilliantly by William James¹⁵ that it seems worth while to quote him in detail. "Many philosophers.... hold that the reflective consciousness of the self is essential to the cognitive function of thought. They hold that a thought, in order to know a thing at all, must expressly distinguish between the thing and its own

¹⁵ James, p. 274—275. Italics in the original.

self. This is a perfectly wanton assumption, and not the faintest shadow of reason exists for supposing it true. As well might I contend that I cannot dream without dreaming that I dream, swear without swearing that I swear, deny without denying that I deny, as maintain that I cannot know without knowing that I know. I may have either acquaintance-with, or knowledge-about, an object O without thinking about myself at all. It suffices for this that I think O, and that it exist. If, in addition to thinking O, I also think that I exist and that I know O, well and good; I then know one more thing, a fact about O, of which I previously was unmindful. That, however, does not prevent me from having already known O a good deal. O *per se*, or O *plus* P, are as good objects of knowledge as O *plus* me is. The philosophers in question simply substitute one particular object for all others and call it *the* object *par excellence*. It is a case of the 'psychologist's fallacy'. They know the object to be one thing and the thought another; and they therewith foist their own knowledge into that of the thought of which they pretend to give a true account. To conclude, then, *thought may, but need not, in knowing, discriminate between its object and itself*". A conscious "of which its bearer knows nothing" is very well compatible with the theory of conscious regions outside the conscious mind, and such regions may exist fundamentally in any required number. Self-consciousness can be a characteristic at most of a conscious mind, as it requires some degree of organization. We shall have to inquire later whether it is an "essential characteristic", as Freud asserts, even of such a mind.

The later development of psychoanalytic theory represented by Fenichel follows Freud in the main but lays its principal emphasis on the ego as a condition for consciousness. For this reason we shall treat it more in detail in a later chapter when we come to discuss the theory of the ego. Fenichel¹⁶ states explicitly that "conscious phenomena are not simply stronger than unconscious ones; nor is it true that everything unconscious is the 'real motor' of the mind", but qualifies this later¹⁷ somewhat with the words: "The first traces of consciousness do not differentiate between ego and non-ego but rather between greater and lesser tension; at this time relaxation is concom-

¹⁶ Fenichel, p. 15.

¹⁷ Fenichel, p. 34.

mittant with loss of consciousness". Where tension exists, a difference in the strength or direction of the processes involved must be assumed, but the constellation of forces can also play a part as well as their strength pure and simple. This is implicit also in the following sentences:¹⁸ "Before a systematic conception of reality can be developed there must of necessity exist a certain unsystematic perception. Consciousness comes into being at some point in the process of systematization. This process depends on the ability to utilize memories." This process of systematization and comparison mediated through memory in contrast to earlier "unsystematic perception" comes very close to the development of an abstract attitude in Goldstein's sense, — an attitude which has nothing to do with consciousness as such. Unsystematic conscious perception belongs to the conscious, systematic conscious perception, especially in relation to an ego, evidently to the conscious mind. A certain haziness results from the failure to distinguish between the two concepts.

Bleuler presents a more highly developed theory of consciousness, as we are led to expect by the title of his book. It is important to note at the outset that, although his psychology is nominally an associationist psychology, he postulates a mode of functioning of the neurological as well as of the psychological processes that goes even further than James beyond the traditional associationist conceptions and is practically indistinguishable, at least in a first approximation, from the field concept of Gestalt psychology. In his own words¹⁹ we hear of "the unity of the psychic elementary functions,.... the confluence or general reciprocal influence of all the various simultaneous psychic functions in the cerebral cortex in the manner, as it were, of a complicated electrical system, in which the electricity from various sources flows together or influences each other by induction". Later²⁰ the ordinary associationist hypothesis of the identity of the structural or functional psychic "elements" with the anatomical units of the central nervous system is expressly rejected as inadequate to account for the complexity of psychic processes even when the anatomical elements are regarded as of molecular dimensions, and he

¹⁸ Idem, p. 17.

¹⁹ *Naturgeschichte der Seele*, p. 58.

²⁰ *Naturgeschichte der Seele*, p. 62.

assumes a "general tonicizing of the nervous system according to the nature of the engram, which can be transmitted to all parts of it".

On this basis Bleuler now develops a twofold theory of consciousness, one aspect of which we shall consider here, the other in the following section. What becomes conscious, he says, is always an alteration of some kind or other in the neurological state of the organism. The alteration can be brought about by external stimuli impinging upon the sense organs and equally by the cessation of their working or by a qualitative alteration in them, by centripetal impulses or by centrifugal discharges, finally by the interaction of dynamic traces within the organism itself. Whence the alteration comes is of no importance; as we perceive nothing but the alteration of cerebral states as it were "from within", never things or even sensory stimuli themselves, percepts and ideas are basically the same. "Perception of anything, whether it be an external object.... or an internal.... is always the same, always something psychic, *potentia* conscious".²¹ In order to be aware of the alteration, it is necessary to do more than apprehend the intermediate and terminal states, each for itself, through which the process passes. Such apprehension, extending nowhere beyond the instant, would lead to no consciousness of alteration. This is given only by the comparison of a former with a present, distinct, and different state. Bleuler concludes therefore,²² "For no thing without memory can there be any perception.... If the former moment has left behind it a trace (engram) that is active or can be reactivated, and if this is still active or becomes reactivated (ecphorized) in the following moment, then the two states are present simultaneously. A difference, a comparison, an alteration, a *perceptual gradient* is present. This, though, only under the condition that the ecphorized and the actual function.... flow together somehow in a unit. This is the case in our nervous system". These two conditions: memory and functional unity (in the sense set forth above) are stated explicitly to be not only necessary, but also sufficient conditions for consciousness.²³ Before going further, we shall pause to remark that the assump-

²¹ Ibid., p. 33.

²² Ibid., p. 39-40.

²³ *Naturgeschichte der Seele*, p. 44.

tion that all perception is based on an alteration in neurological conditions is at least questionable. It seems to be contradicted by Metzger's²⁴ experiments with homogeneous fields of stimulation and by the experience of anyone who has lain on his back on a summer day and gazed into a cloudless sky. Physiology finds that the peripheral nervous system is capable of sustained action as a result of continuous stimulation, and it would be rather remarkable if the perceptual apparatus were not. The objection that "continuous" stimulation or the nerve currents resulting from it take wave form is irrelevant here, for the extremely rapid pulsations of the central or peripheral action currents are never perceived as such, whereas Bleuler clearly equates the form of the physical alteration with that of the perception. This leads us to note another questionable assumption at the basis of his argument. Even if it be true that neurological alteration is the condition of all perception, it is by no means requisite that the resultant perception be a *perception of this very alteration as such*. The unperceived pulsations of nervous action currents are a case in point. — These functional conditions of consciousness furnish the ground for the assertion quoted above that "not the brain possesses consciousness, but a complex of central nervous functions".

Bleuler postulates, exactly as James does, the uninterrupted temporal continuity of the psychic process,²⁵ "no multiplicity [of engrams], but....in reality only *one* untampered engram that begins with the moment of the cerebral cortex's functioning and is spun out continuously up to its death. Thus the alteration, the difference, the possibility of comparison is contained in the engram itself, and not only the difference between the single moments of the past, but also the important difference between the past and the present". In such a temporally and dynamically continuous field it is obviously possible for temporally discrete events or their traces to flow together in a single resultant, as Bleuler indeed recognizes. When they do so, however, the perceptual gradient disappears, and no consciousness results. Consciousness follows only when the old trace and the

²⁴ Metzger, W.: "Optische Untersuchungen am Ganzfeld. II. Zur Phänomenologie des homogenen Ganzfeldes". *Psychologische Forschung* 13, pp. 6—29 (1930).

²⁵ *Naturgeschichte der Seele*, p. 45.

new process are simultaneously present and interact while remaining distinct from each other. This is a point of basic importance and helps us to a further understanding of the whole question when we recast Bleuler's hypothesis in terms of field theory. The field must be conceived as initially homogeneous. Inhomogeneities in it, resulting from whatever outer or inner stimuli, create gradients and lead to the differentiation of perceptual objects in the field. The inhomogeneities may be relatively stable or temporally mutable. The presence of a single inhomogeneity in a dynamic field creates a field gradient just as well as the presence of several. Thus, whether several inhomogeneities coalesce or remain discrete, a gradient will be at hand, and their coalescence does not destroy the perceptual gradient, as Bleuler affirms. The perceptual gradient, or any gradient, therefore cannot be in itself the condition of consciousness on his assumptions. The intrusion of inhomogeneities and the resulting efforts of the organism to equalize them in such a way as to preserve its own characteristic organization with a minimum of tension constitutes in essence the process of learning according to Humphrey's²⁶ carefully detailed interpretation, and learning can proceed unconsciously as well as consciously. When, however, such an equalization takes place, or when two processes or traces so interact as to produce only a single resultant in which the original processes are no longer distinguishable, then it is obvious that the gradient between the equalized inhomogeneity and the remaining field, or between the two coalescing processes, must be a *continuous* one in the mathematico-physical sense. When, on the contrary, two processes or traces interact while preserving their respective identities, we are compelled to assume a *discontinuity in the field* between them. This is Bleuler's condition of consciousness — not a mere inhomogeneity, a gradient, but a *discontinuity in the field*, which naturally has nothing to do with his and James's postulate of the temporal continuity of the psychic process. The existence of a discontinuity at some point in the field is no condition of consciousness in fact, as we have seen already and shall attempt to demonstrate in more detail later, but it is a condition for the segregation of the field into figure and

²⁶ Humphrey, George: *The Nature of Learning*. New York: Harcourt, Brace, 1933.

ground and thus for its basic organization into ego and non-ego. For this reason Bleuler is then led to set up this second theory of consciousness, according to which consciousness is a result of connection with the ego. We have seen earlier (cf. p. 16) that Bleuler, while he states in one place²⁷ unequivocally that "everything conscious is associated through many connections with the ego" is far from upholding this view consistently. His reference to "consciousness in general" in contrast to "becoming conscious to a complicated ego"²⁸ makes it evident, as do many other passages besides, that the consciousness which arises from connection with the ego is *self-consciousness*, the foundation of abstract behavior, and not consciousness simply as a quality of psychic events. As Jung has taken over his theory of consciousness from Bleuler with a slight modification, we shall consider this theory in connection with analytical psychology, and later also with Gestalt psychology.

3. *In Analytical Psychology*

Jung²⁹ states his condition for consciousness in the following words: "By consciousness I understand the relatedness of psychic contents to the ego in so far as they are sensed as such by the ego. In so far as relations are not sensed as such by the ego, they are unconscious. Consciousness is the function or activity which maintains the relation of psychic contents with the ego." This condition: reference to the ego that is felt as such by the ego, undoubtedly is presented here as a necessary one. Whether Jung also regards it as sufficient, as Bleuler does, is not evident from the passage in question. Another place, in which the energetic factor is introduced, makes it probable that he does not. Thus he writes,³⁰ "Since regression raises the value of those contents that were before excluded from conscious adaptation, and hence are either unconscious or only 'darkly conscious',.... psychic elements.... are.... being forced over the threshold"; and again,³¹ "In this case [i.e. when

²⁷ *Naturgeschichte der Seele*, p. 52—53.

²⁸ *Ibid.*, p. 54.

²⁹ *Psychological Types*, p. 535—536.

³⁰ Jung, C. G.: *Contributions to Analytical Psychology*. Translated by H. G. and Cary F. Baynes. London: Kegan Paul, 1928. p. 37.

³¹ *Ibid.*, p. 38.

I will think directly] I withdraw as much libido as possible from the feeling process, so that this function becomes relatively unconscious". In another place³² we read, "We know by experience that conscious contents can become unconscious through loss of their energetic value". The general conclusion is clear: the becoming conscious or unconscious of the respective contents is effected by charging them with or depriving them of libido. The same view is expressed in many other psychologies, where we hear of a "threshold of consciousness" or a "reduction of the level of consciousness", by virtue of which contents that have lain hitherto in the unconscious stream over into the conscious like water into a bucket held below the surface. We have said above advisedly "effected" and not "conditioned", for it is nowhere apparent from the quoted passage that an alteration in the libido charge is regarded either as a necessary or sufficient condition of an alteration in the degree of consciousness of the contents in question. By other psychologists it is unquestionably assumed to be such. Jung rather denies it expressly with the words,³³ "A complex would not be such at all if it did not possess a certain, even a considerable, affective intensity; and one might expect that this energy would automatically force the complex into the conscious, in short, that the power of attraction contained in it must perforce draw conscious attention. (Fields of power attract one another mutually!) A special explanation is required for the fact revealed by experience that the complex nevertheless often fails to become conscious". The view that a content of the unconscious can be "raised" into the conscious by means of an augmented libido charge alone or, in other words, that consciousness is a function of the energy charge, is refuted at once by the experience that precisely such contents of the unconscious as complexes can possess a very high charge of energy and yet remain unconscious. Jung, though, does not regard the libidinal charge in itself, but the attraction of conscious attention conditioned thereby as the factor which can, but must not necessarily, lead to consciousness. We shall return to this question later on. We have encountered attention as a factor making for consciousness before. If we define it in the Freudian

³² *Psychological Types*, p. 614.

³³ *Contributions to Analytical Psychology*, p. 10, fn. 1.

sense as simply a surcharge of libido, then we are confronted again by all the difficulties we met when discussing the psychoanalytic theory. On the other hand, if we take Jung's "conscious attention" because of this new attribute to be some special agency of the conscious mind, we can hardly conceive it in this connection apart from the ego and are faced by other difficulties arising from the inadequacy of all the theories that make the ego a condition for consciousness. We have reviewed some of them already; others disclose themselves most readily in connection with the Gestalt theories, to which we now turn.

4. *In Gestalt Psychology*

Within the Gestalt school itself differences of opinion exist concerning the psychological conditions for consciousness (into the physiological we will not go), and even individual Gestalt psychologists seem scarcely able to reach an unambiguous decision about them. Thus Koffka writes in one place,³⁴ "Just as I know my behavioral environment, so I know myself and my behavior in this environment. Only if we include this knowledge with the behavioral environment have we gained a complete equivalent of what Köhler calls direct experience, or what is called consciousness". Here the affirmation of the condition that the content must be related to the ego and must be sensed as such by the ego is clear. In another place³⁵ Koffka asserts, and adduces evidence therefor, that pleasure and displeasure, pain and joy can be felt without an ego. One instance that he gives, a description by the Viennese professor Eugen Guido Lammer of how he regained consciousness after a dangerous fall into a crevasse while traversing a glacier, is worth quoting in full. It reads in Koffka's translation:³⁶ ".... fog.... darkness....fog.... whirringgrey viel with a smaller light spot....fog....faint dawn.... a soft hummingdull discomfort....fog.... something has happened to somebody....gloomy fog, and always that lighter point....a shivering shudder: something clammy....fog....how was it?an effort at thinking....ah, still fog; but besides that light

³⁴ *Principles of Gestalt Psychology*, p. 39.

³⁵ *Ibid.*, p. 327.

³⁶ *Ibid.*, p. 323.

point there outside, there emerges a second point there inside; right, that is *I!*....fog, dull ringing sound, frost....a dream?Yes, indeed, a wild, wild, wild dream! — It has dreamed — no, rather *I* have dreamed....". Koffka breaks off his quotation here and remarks, "The part so far quoted....shows....that phenomenally quite a long period of time passed without an Ego, a period which began with as complete a homogeneity as we can imagine. The Ego did not even emerge with the first articulation of the field, the light point, not even with the first feeling of discomfort, and apparently not even with the first conscious thought..". Now, this account does not stand alone. James³⁷ furnishes other examples, and yet others are no rarity in the literature. Many will have gone through a similar experience when emerging from an anaesthetic or a deep sleep. Koffka makes a similar affirmation for thoughts and quotes a dream in which a question is directed to the dreamer that not he, but another person in the dream answers. "In this dream", says Koffka,³⁸ "occur two thoughts and both in minds that are not the dreamer's Ego, although they are in his dream. The question is asked by the examiner, and the right answer is given by a student, while the Ego of the dreamer was unable to produce it. The answer then occurs in the dreamer's field, but not in that part of it which makes up his Ego". The process, the answer, is thus referred to the dreamer's ego, but the reference is *not* felt as such by the ego. In the previous example even all self-consciousness and thus the ego-relatedness of the clearly perceived affective quality was lost. Metzger³⁹ remarks, "When only consciousness of self is lacking, we do not speak of unconsciousness, but of being carried off, beside oneself, sunk in oneself, or simply of forgetfulness of self", while the consciousness of certain psychic contents can be preserved. Finally we may inquire ourselves: If the relatedness of the conscious content to the ego must be *sensed*⁴⁰ as such by the ego, is not

³⁷ *Principles of Psychology*, Vol. I, p. 273ff.

³⁸ Loc. cit., p. 327.

³⁹ *Psychologie*, p. 267.

⁴⁰ In German "empfunden". Jung has proposed in a communication to the author to replace "empfinden" here by "wahrnehmen", i.e. "perceive". This alters nothing, however, in our argument: the essential fact is the postulated awareness of the relatedness under whatever name.

this *sensing* already conscious and the definition therefore a *petitio principii*? According to Jung and most of the authors quoted there are unconscious feelings or perceptions; but if this sensing or feeling is unconscious, how can one make sure of its presence at all, or how make sure that its presence is necessary?

We experience often enough that complexes whose presence in the unconscious and whose structure we have inferred from the behavior of their bearer or by such experimental means as the Rorschach test or the word association experiment are made conscious while in the conscious nothing is altered in their structure, in the relation of their components to each other, or in their feeling tone. The same object that we encountered previously in the unconscious is now to be found without any essential alteration in the conscious. This can be the case for example with a wish that for a long time, as we subsequently recognize, determined our actions until we confessed it to ourselves and accepted it as a conscious motive, or with an attitude or manner of thinking that we recognize only by its fruits. As a consequence of such a recognition a change *can* occur, but that it need not do so in every case in spite of all pretty theories concerning the healing effect of making conscious is an empirical fact so painfully familiar to every practical psychotherapist that a mere reference to it is sufficient. If a change does occur, it does not even require to affect the content just become conscious, for this can continue to exist unaltered as a kind of "correction", while the conscious mind adjusts itself to it. That the energy charge with which the respective content is laden can remain the same at its transition from the unconscious into the conscious and the reverse has been mentioned already. (This charge naturally can undergo an enforced *relative* alteration in as much as its positional value can become different in a new region). Thus we see that in the becoming conscious or unconscious of a psychic content every thing *can* (but must not and usually does not) remain unchanged: the components and the structure of the content itself, the feeling tone, the libidinal charge, the relation to the ego, only that it is now conscious where it was unconscious before, or the converse. We seem to know not more but less than at the outset of our investigations.

VI. POLAR AND CONFIGURATIONAL PROPERTIES OF PSYCHIC
REGIONS AND SYSTEMS

In the dilemma of the preceding chapter a comparison suggests itself. Such systemic states as we have described are not unknown in lifeless nature. The essential feature of them is that two points, corresponding symmetrically to one another, of the same more or less closed symmetrical system are distinguished from each other only in respect to a single basic, polar property. One can think of functions and their curves symmetric about an axis in mathematics, of two-phase diffusion systems in physical chemistry, and of magnetic or electric fields, or of magnetically or electrically charged bodies. This last example is especially instructive. When we lead an electric current through a symmetrical conducting body from any one point to the corresponding opposite symmetric one, then in all pairs of geometrically corresponding points in both halves of the body in question we have the same tension, the same intensity, and the same distribution of current in reference to all other symmetric pairs of points; only the two points compared with each other have respectively *different signs*. If we reverse the direction of the current everything remains the same; only the signs change. The same holds approximately for the diffusion system: if we have the same mol-equivalents of different ions at different places in our system, then all relations of quantity, concentration, and distribution in both halves of the system remain symmetrically the same as the process of diffusion goes on; the only difference consists in that between the different kinds of ions (if we disregard for the moment their different velocities of diffusion, which again are founded on the substantial nature of the ions). By reversing the poles or exchanging the substances we get the same relations once more but with different signs. Further, if we put a resistant or conducting body into an electric field in two symmetric places one after the other, it will cause the same disturbances in the distribution of the charge in both halves of the field. If the field be asymmetric, then we get, after reversing the poles, the same relations once more with a changed sign of the whole, but in a field region of given sign quite different ones. An uncharged or a charged isolated body in the field will cause different disturbances according to the region of the field into which we

put it, but the difference in the disturbance will have to be referred to that of the asymmetric field regions among themselves and thus to the positional value of the body itself, not to the body's charge having got a different sign because of its displacement. But if we alter the sign of an already present charge of the body (now no longer to be thought of as isolated) while this disturbing body's position and also the direction of the current remain the same, we shall have to expect alterations within the system as a whole. The similarity with the relations described above as holding for the transition from the unconscious to the conscious and the converse is manifest, and the question puts itself, whether we do not have to do in the psyche also with such systems and properties, which we shall designate for the sake of brevity as *polar properties*?

We have thus found in the realm of physics an analogy to certain phenomena in the realm of the psyche. Fruitful and indispensable as the method of analogies is in psychotherapy, just as dangerous is it in exact science when it transgresses the boundaries of its true mission as a mediator of ideas and hypotheses. We have proved nothing as yet with our analogy, but must look about us for proofs. For a proof we need to be able to demonstrate:

1. that the psyche as a whole can be regarded as a field, and its processes as field processes;
2. that from the very beginning polarity belongs to the nature of the total psychic field.

The first was long a basic postulate of Gestalt psychology, without which a Gestalt psychology would be scarcely conceivable, and has been elevated by a long series of careful observations and experiments, especially by Wolfgang Köhler, to a fact. As Köhler¹ has presented the evidence for it comprehensively and compellingly, we shall not repeat it here. Gestalt psychology on the other hand knows nothing of a basic polarity of the psychic field, although it concedes at once the possibility of the formation of poles within a given field. Thus Koffka² observes, "Anticipating, we can say that the psychophysical field is organized. First of all it shows the polarity of the Ego and the

¹ Köhler, W.: *Dynamics in Psychology*. New York: Liveright, 1940.

² *Principles of Gestalt Psychology*, p. 67. Cf. also Köhler, W.: *Gestalt Psychology*, New York: Liveright, 1929. P. 323.

environment, and secondly each of these two polar parts has its own structure". The ego, though, is not present from the beginning, given, but must first be constellated and differentiated from the field. The same holds for the other polarities. Metzger³ and Koffka⁴ have made significant investigations into homogeneous, non-polar fields and have shown that the organism under all circumstances strives to transform the homogeneous field into a structured, organized, and thus polarized one, which allows us at least to suspect an inner compulsion through an inherent property of the perceiving subject himself. A homogeneous field of stimulation is further, as both the psychologists named emphasize, a decidedly artificial product. The subjective one is always structured with rare exceptions, of which we have quoted one above.

If we seek the proof of our second postulate in vain in Gestalt psychology, we find it nevertheless in Jung, who has made the postulate a corner-stone of his psychological system. We do not meet it there, to be sure, under the name of polarity, but under that of the law of complementariness, of the complementary or compensatory relation of all paired psychic functions to each other. Its unlimited validity is emphasized by Jacobi:⁵ "All that has yet been said concerning the structure of the psyche — concerning functions, attitudes, relations of consciousness to the unconscious, of the dream to the waking state, etc. — has been regarded from the point of view of the law of complementariness, according to which the various psychic factors stand in complementary or compensatory relation to each other. But this law holds too in each of the partial systems,....". After such formulations we could easily fear that this principle was valid only for a functional relationship, not for properties of psychic contents. But Jung⁶ says, "It is an essential property of the psychic figures that they are double or at least capable of being doubled; at all events they

³ Metzger, W.: "Optische Untersuchungen am Ganzfeld. II. Zur Phänomenologie des homogenen Ganzfeldes". *Psychologische Forschung* 13, pp. 6—29 (1930).

⁴ *Principles of Gestalt Psychology*, Ch. IV.

⁵ Jacobi, Jolan: *The Psychology of C. G. Jung*. Translated by K. W. Bash. London: Kegan Paul, 1942. P. 52.

⁶ Jung and Kerenyi: *Prolegomena to a Science of Mythology*.

are bipolar....". And Jacobi dispells all further doubt with the words,⁷ "For all these pairs of opposites are conceived not only according to their content as opposites, but also in reference to their dynamic efficacy". In view of Jung's emphasis on a dynamic point of view it is not strange that he speaks almost exclusively of the polar *behavior* of psychic contents and functions. It is apparent, though, that the basis for such regular behavior can only be sought in an already present, not merely accidental or accessory polarity of the psyche itself, as in physical systems too the inherent polarity forms the basis for numberless equilibrating processes such as diffusion, osmosis, the distribution of static electricity on a charged body, and the like. Undoubtedly Jung would concede polarity to the pair of opposites: the conscious mind and the unconscious mind. We believe ourselves justified on the basis of his researches in assuming the same just as well for the pair of opposites: consciousness and unconsciousness, and consequently also for the regions of the conscious and the unconscious distinguished by these characteristics.

According to what has been said, consciousness and unconsciousness would be polar properties standing in reciprocal reference to each other, comparable more or less to positive and negative electricity. They would be, like the latter, markedly systemic properties and would admit all steps and transitions between the poles of the systems. They are by no means absolute properties, neither in the sense that any content would have to be either wholly conscious or wholly unconscious, nor in the sense that a given content would always have to occupy the same place on the scale conscious-unconscious. Clinical psychiatry is long accustomed to speak of various gradations or levels of consciousness.⁸ In the unconscious we are likewise acquainted with various layers distinguished from each other not only according to their contents, but also, as it were, by

⁷ Loc. cit., p. 52.

⁸ One of its representatives, Zutt ("Ueber die polare Struktur des Bewusstseins. Durch psychiatrische Erfahrungen mit Pervitin angeregte Gedanken". *Nervenarzt*, Jhrg. 16, Heft 4 (April, 1943), p. 145—162), has recently assumed as an explanation thereof a "polar structure of the conscious mind", in which one pole comes dangerously close to lying in the "unconscious mind", whose existence this psychiatrist however expressly denies.

their distance from the conscious. In each layer, on every transitional level between the poles we encounter the most manifold contents, now these, now those, although there are undoubtedly such as cling preferentially to a certain polar region. One calls to mind here the contents of the collective unconscious, of which Jung posits that they never can be made wholly conscious. That a reversal at least of all other usual situational relations in respect to the conscious or the unconscious is possible, however, is demonstrated by the pathological cases in which the conscious is inundated by the contents of the collective unconscious, or in which an undifferentiated, for the most part unconscious function dominates the conscious mind.

Besides those conditioned by circumstances, there are numerous polarities regularly to be encountered in the psyche, which we have even cited in support of our thesis as to its fundamental polarity. One will ask: Are these all different polarities of mutually independent properties, or are they all expressions of a single polarity that we behold in its purest form, it may be, in the pair of opposites consciousness-unconsciousness? I should not care to venture a definitive answer to this question in the present state of our knowledge. We can merely say that it is possible to observe as a rule certain couplings of polarities, that these couplings however are conditioned by circumstances in the highest degree and therefore create difficulties for the conception of all polarities as a form of manifestation of a single basic one. Let us take sexual polarity as an instance. Here the feminine is as a rule unconscious in the man, the masculine in the woman likewise, the coupling of a conscious and an unconscious portion of the psyche respectively thus wholly dependent upon circumstances as far as their content is concerned. But there too there are exceptions. A decision is scarcely possible.

A content of a psychic system may be displaced in respect to the two poles and thus receive a new positional value. Its positional value can also become altered as a result of an alteration in the field, while the absolute energy charge of the content remains approximately the same. We say with intention and emphasis "approximately", for it can remain wholly constant only when the content in question constitutes an entirely closed, isolated body or system. Such a system is

present, though, if at all, only in extremely pathological cases; otherwise we always have to do with relatively closed partial systems. Thus the partial system, the body in the surrounding field, will itself undergo a more or less pronounced alteration as a consequence of every alteration of the field according to its degree of closedness. If the sign of the surrounding field is altered by the access of considerable energy charges with an opposite sign, then under the given circumstances the alteration will be transmitted only in a very slight degree to the relatively closed partial system, which consequently now receives a different sign from that of the field about it. Thus it probably happens when a hitherto unconscious region — it may be through affectively directed accession from the conscious — receives an increase of conscious libido and consequently becomes conscious as a result of a new and different charge (nor more of an augmented charge!), while "blind spots", obscure places determined by complexes, remain within the newly conscious region. A common experience in point is a dream that brings into the light of the conscious a considerable region that was hitherto unconscious, but in which one or more figures remain shadowy and undefineable, more felt than perceived, only to reveal themselves in the later course of an analysis as representants of particularly strong repressions. Another case, which very prettily illustrates the working of configurational factors, is mentioned by James.³⁹ A stroke is made on paper or blackboard, and blindness for it is suggested to an hypnotic subject. He then does not see it, but he sees at once other strokes made after the suggestion in the immediate vicinity of the first, i.e. the field about it is made conscious through being structured by the additional strokes and through the command to regard it, while the original stroke, which has been segregated artificially from the rest of the field, remains unconscious. If new strokes are made in such a way that the original one becomes a member of a series of strokes and the subject is asked to count them, he will count correctly all but the original stroke in spite of the pressure exerted by the serial configuration, which tends to break down the segregation. If the pressure is further increased, though, by adding lines to

³⁹ *Principles of Psychology*, Vol. I, pp. 211—213.

the first stroke so as to make it part of a drawing of a face, for example, then the subject will trace correctly the full outline of the face including the stroke to which he was "blind" before. The segregation has been broken down by the inclusion of the stroke in a stronger Gestalt, and thereupon the enhanced conscious libido charge of the surrounding field flows over into the previously segregated region, making it now also conscious.

The converse case would be that the relatively closed partial system as a strong structure in a weakly organized field would bind the newly acceding libido charge of opposite sign, as for instance an irregular body with many edges and corners in an electric field does, so that its sign, but not that of the field, would change. We are familiar with an analogous phenomenon in the dream. Without doubt the dream contents are as a rule strong or "pregnant" configurations, practically always of the nature of complexes, and thus relatively closed partial systems. If now a quantity of libido with a conscious sign flows over into the unconscious as in sleep, it charges the dream contents to be found there, which now likewise acquire the sign of consciousness while remaining in the unconscious mind. In the dream we live thus, as it were, upon an island of the conscious, where consciousness pertains to everything upon the island, but where the systemic principles of the conscious mind have little or no validity. Round about us in sleep is the unconscious. We have mentioned at the beginning that it is not permissible to speak of the dream content as a so-called "unconscious" content, although it typically belongs to the unconscious mind, comes out of the unconscious, and sinks back into it, and we now understand the theoretical basis of this objection. We further discover an answer to the question as to how the dream contents can become conscious to us in sleep without the conscious mind integrating them into its system. For it can happen that the dream exercises an immediate effect upon the conscious mind too, even one that can be ascertained objectively in the altered behavior of the dreamer; but more frequently the dreams remain even after waking more or less mysterious inclusions, whose integration into the conscious mind is only made possible through a process of interpretation. In the first case we must assume that the region becoming conscious in sleep includes not only a circumscribed repressed complex, but

a portion of the psyche communicating with the conscious mind as well; in the second, that the integration into the conscious mind affects the memory image of the dream present upon awakening, not the immediate dream experience itself. We recognize the relative isolation of the dream images from the conscious mind and the role of their memory images in their subsequent integration most clearly in the fact that on awakening we are often certain of having dreamed without being able to recall a single content of our dream. The relativity of consciousness and unconsciousness referred to above, the importance of positional values of psychic contents, and the part played by more or less closed sub-systems within systems are all illustrated with paradigmatic clarity also in the phenomena of the dream, namely when we dream that we dream, or dream that we dream that we dream.¹⁰

The consideration of the dream teaches us that the conscious mind is not simply identical with the conscious, and we may assert the same of the unconscious mind and the unconscious, for we observe often enough that contents of the conscious strongly charged with affect and possessing the nature of complexes follow the irrational laws of the unconscious mind and behave in the well ordered conscious household like undisciplined children or ruthless intruders, while we, fully conscious, can do naught but look on at the mad game. Or we are aware of some content of the conscious but do not recognize its significance in our present situation and deny afterward ever having been conscious of it. In both these cases, the fact is, as Gestalt psychology already has suggested, that the contents in question were present in the conscious but not integrated with the conscious mind, i.e. the Gestalt relation with the rest of the conscious was wanting. Metzger¹¹ says on this point: "Just as no spatial form and no melody can be perceived unless the configurational integration requisite thereto has been effected, even though none of the necessary components as stimuli be lacking, so likewise do the sequences of cause and effect remain wholly concealed from us when the events are

¹⁰ The idea of such a scale of ever more circumscribed and less broadly conscious psychic states has been utilized masterfully for artistic purposes by Gustav Meyrink in his novel *Der Golem*.

¹¹ *Psychologie*, p. 126.

not integrated behaviorally (*anschaulich*: cf. above) in the proper way. This holds for certain relations between cause and effect in our own inner world, i.e. for the relations between motives and actions, no less than for such as we observe outside us. From this viewpoint a group of cases from psychopathology becomes understandable to which physicians up to now have applied the concept of the 'unconscious', although all the essential facts, piece for piece, were accessible to the conscious of the persons in question. What is lacking here is in many cases only their proper connection". Jung¹² probably had something similar in mind when he wrote, "There are two distinct ways in which we see consciousness come about. The one is a moment of high emotional tension comparable to that scene in Wagner's *Parsifal*, where Parsifal, in the instant of greatest temptation, suddenly realizes the meaning of Amfortas' wound. The other way is a contemplative condition, where representations move like dream-images. Suddenly an association between two apparently disconnected and remote representations takes place, through which a great amount of latent energy may be released. Such a moment is a sort of revelation. In each case it is a concentration of energy, arising from an external or internal stimulus, that brings about consciousness". In the first case it is increased configurational pressure from without, in the second the reduction of tension between the contents in question that leads to their sudden integration and coalescence, very much after the manner of two contiguous bubbles or drops that of a sudden merge into one. What arises then obviously is not consciousness in a strict sense, but a significant change in the Gestalt structure of the conscious mind together with the awareness of a new meaning. Gestalt psychologists speak of "insight" in such cases.

A dream of a patient of mine during analysis illustrates quite clearly what is meant here and seems to lend support to our theory. The translation follows the patient's written text as closely as possible; the italics correspond to the patient's own underlinings. He wrote: "I am lying diagonally on my bed in my room at home. In this position I become conscious in the dream. — I have a head, which I recognize as my own head, between my hands over my breast, over the heart. I regard the

¹² *Contributions to Analytical Psychology*, p. 365.

head; its eyes are open; no doubt, the head is *not dead*; but the features remain unchanged, they do not play as long as I look at the head. — Now I become conscious of the strange condition in which I am, and therewith I already observe how that is really possible. I feel that I actually have no head on my neck, indeed *I see that too*. The head is divided from the middle of the neck. I observe no wound, though.... on the other hand it is as if cloudlike bands went out from both severed parts, through which the head evidently has a connection in some way with the body. I observe that my thinking has its conscious seat in the place where the head really belonged on the neck.

"Now I feel that it is time for thought, consciousness to be put back into the head and this in its proper place again. I feel that this must take place at once if a transformation is not to occur that I cannot yet overlook clearly. As I do not want to loose the ground under my feet, I endeavor to restore the normal state again quickly. I think and feel entirely clearly: I must preserve my consciousness where it already is; but at the same time I must bring consciousness into the head over my breast and therewith put the head back into its proper place. While I am doing this, the dream is interrupted at once, but I still experienced the act itself".

Here the displacement of the conscious mind from its customary seat, the head, is described first with all desirable clarity, thereupon a splitting and displacement of the conscious, which is divided between the dreamer himself and his dis-severed but still living head, while the active and reflective, formative conscious mind remains exclusively with the subject. The head does not act, does not think, does not "play", as the dreamer writes, and is nevertheless provided with consciousness, since it evidently perceives. It regains a conscious mind, though, only when it is joined to the body again, i.e. after its re-integration with the more inclusive system, the super-ordinate Gestalt.

It is possible to interpret in the same way, as projections of certain basic facts of psychic organization, the stories of Frankenstein, of the Golem, and of other similar creatures fashioned by men, not wholly automatic or robot-like, but instinct with a kind of dull and primitive (or else exalted) life, possessing consciousness as their awareness of persons and

things in various situations shows, but acting unreflectively, often with terrifying concreteness, and with none of the checks that the conscious mind commonly imposes.

A further support from a very different quarter for the view that consciousness and unconsciousness may constitute basic, primary properties of the psyche is to be found perhaps in the results of investigations with the electro-encephalogram.¹³ We find there that both during mental activity in a waking state and also during such dreams as can be recalled afterward a recognizable rhythm is lacking. But in a wholly passive waking state empty of thought on the one hand, and in a state of deep sleep troubled by no dream capable of being recalled on the other, a typical rhythm is present, but in each case a *different one*. In the waking state it is represented by the well known α -waves discovered by Berger with a frequency of around 10 per second, in deep sleep by the so-called "spindles", short trains of waves with a frequency of around 14 per second. In a still deeper coma-like sleep and in coma itself only the slow δ -waves are irregularly present, which first make their appearance at the onset of sleep and then diminish steadily in amplitude and frequency as sleep becomes deeper, while the spindles, and much earlier still the α -waves, vanish. A regular wave-pattern in the electro-encephalogram points to a synchronous activity of all cells of a given cortical region or of the cerebral cortex as a whole and thus to a practically homogeneous state of the psychophysical field, which is naturally disrupted by the occurrence of a perception, thought, or dream. This accounts for the disappearance or rather disruption of the rhythm in waking mental activity and in the dream as well. The characteristic difference in the frequency and type of the rhythms in the two homogeneous field states, the one conscious, the other unconscious, suggests that these states may correspond to two fundamentally different conditions of the field. The arrhythmia

¹³ Cf. on this subject Davis, H., P. A. Davis, A. L. Loomis, E. N. Harvey and G. Hobart: "Human Brain Potentials During the Onset of Sleep". *Journal of Neurophysiology* I (1938), 24—38. Blake, H., R. W. Gerard, and N. Kleitmann: "Factors Influencing Brain Potentials During Sleep". *Journal of Neurophysiology* II (1939), 48—59. Bertrand, Ivan, Jean Delay et Jacqueline Guillemin: *L'Electro-Encephalogramme Normal et Pathologique*. Paris: Masson, 1939. Jung, Richard: "Das Elektrencephalogramm und seine klinische Anwendung. II". *Nervenarzt*, 14. Jhrg. (1941), 57—70.

of the persistent δ -waves on the other hand leads one to suspect a primary state without psychic organization, or with only rudimentary organization, out of which the two typical rhythms emerge. It must be remarked, though, that the interpretation of the findings mentioned is still a matter of debate.

We may mention here also that Kornmüller's¹⁴ demonstration of localized simultaneous electric rhythms of manifold characters within circumscribed, often very sharply defined areas of the cerebral cortex provides us at least with an indispensable physiological basis for the previously developed hypothesis of segregated regions of the conscious within the unconscious and *vice versa*. For, if the physiological field be identical, or at least isomorphic with the psychological one, then it must afford us, if our hypothesis is to hold, the possibility of forming discrete sub-regions, between which and other parts of the field discontinuities exist. Kornmüller's work shows that this possibility is indeed present in principle.

The recognition that the conscious mind and the unconscious, the unconscious mind and the unconscious are by no means the same thing helps us to overcome another difficulty arising from our polar theory. Namely, if consciousness and unconsciousness be in truth polar properties present in every psychic system and inseparable from each other, then the one never can exist or have existed without the other. Accordingly, there will be no state of organized psychic life that was exclusively conscious or exclusively unconscious, and just as little will there be any evolution or derivation of the conscious out of the unconscious. This thesis, which is based on the polar organization of the psyche, naturally does not hold for states in which or out of which no psychic systemic properties are demonstrable, as for dreamless deep sleep of which nothing can be recalled, faints, coma, or narcosis, in which as a matter of fact regular electroencephalographic rhythms fail. Likewise the not infrequently heard assertion that animals and little children have no "consciousness" need cause us no difficulty, for it is empirically as little demonstrable as the contrary. We have seen, though, that Freud unquestionably regards the unconscious as primary, and Bleuler and James similarly take consciousness to be a product

¹⁴ Kornmüller, A. E.: *Die bioelektrischen Erscheinungen der Hirnrindenzellen*. Leipzig: Thieme, 1937.

of phylogenetic evolution. Jung's view is in the main similar, but in one place¹⁵ he writes significantly, "Unconsciousness (*Unbewusstheit*) is the original sin, evil pure and simple — for the Logos. The cosmically creative and liberating deed of the latter, though, is matricide, and the spirit that ventured into all heights and depths must, as Synesius said, endure the divine punishment, its fesseling to the rocks of the Caucasus. *For neither can be without the other, because both were one in the beginning and will be one in the end.* The conscious mind (*Bewusstsein*) can only exist if it submits constantly to the unconscious mind (*das Unbewusste*), as everything that lives must undergo many deaths". Elsewhere¹⁶ we read: "Our conscious (*Bewusstsein*) does not create itself but springs out of an unknown depth. It awakens gradually in the child, and it awakens every day out of the depths of sleep from an unconscious condition. It is like a child that is born daily out of the maternal primary ground of the unconscious". Such quotations could be multiplied. The second half of the italicized sentence above is wholly compatible with the thesis of the origin of consciousness out of unconsciousness, but the first is of especial significance as referring to the mutual dependence of the two and even negating in a certain sense what the latter half affirms. For if *neither* (not only the conscious) can be without the other, then how can *one* (the unconscious) *have been* without the other?

Furthermore, as is well known, Jung holds that a "collective unconscious" was there long before any consciousness existed. We shall not enter here into a consideration of the factual grounds that make his affirmation in the highest degree plausible. Without doubt it is possible to observe both phylogenetically and ontogenetically such a process of growth as not only Jung, but also nearly all depth psychologists assume, through which the conscious, and the conscious mind also, has increased from the smallest beginning both in extent and richness of content. The result, and the special characteristic of the conscious mind in contrast to the unconscious mind is, apart from the degree of

¹⁵ Jung, C. G.: "Die psychologischen Aspekte des Mutterarchetypus". *Eranos-Jahrbuch* 1938. Zürich: Rhein-Verlag, 1939. Pp. 430—431. Italics ours.

¹⁶ Jung, C. G.: *Zur Psychologie östlicher Meditation*. St. Gallen: Tschudy, 1943. P. 15

consciousness of their respective contents, a greater differentiation and integration in one, a higher degree of configurational structure and organization, which characterizes these "minds" as systems in addition to the abstract and concrete attitudes. The conscious mind tends to form a pregnant Gestalt. How little this has to do with a mere increase in the extent of the conscious, and how easily confusion arises through failure to distinguish between the concepts of the conscious and of the unconscious mind, is nowhere more clearly evident than in a passage that Jacobi¹⁷ found it necessary to add to the second German edition of her book on the psychology of Jung. It reads: "'Becoming conscious' (*Bewusstwerdung*), as Jung uses the term, means more than simply 'to perceive', 'to take notice of', or 'to become aware of'. It has no specific object and signifies the development of a deeper, wider, more intensive and percipient conscious mind, capable of realizing and assimilating to the utmost whatever it apprehends from without or within.... We have to do here not with 'consciousness' in the usual sense, not with the realm of the psyche guided and dominated by the rational, but on the contrary with a kind of 'higher consciousness', which at once maintains a relation to the psychic contents of the ego and the connections of these latter with the unconscious mind". One cannot fail to recognize that what is meant here are the systemic properties of the conscious mind, the abstract system, not the polar property of consciousness or of its region, the conscious. Accordingly, we can leave intact Jung's theory of the genesis of the conscious mind while holding to the view that both consciousness and unconsciousness are present from the moment in which it becomes possible to speak at all of a psychic organization, in Gestalt terminology of an inhomogeneity in a dynamic field.

It is of interest to note that Jung's thesis as quoted ("For neither can be without the other,....") has been stated by Koffka¹⁸ very similarly from the Gestalt standpoint: "The un-

¹⁷ Jacobi, Jolan: *Die Psychologie von C. G. Jung*. Zweite erweiterte und vollständig neu bearbeitete Ausgabe. Zürich: Rascher, 1945. This passage is contained in a slightly different form in the first English edition (*The Psychology of C. G. Jung*. London: Kegan Paul, 1942. P. 45, fn. 4 and 5).

¹⁸ Koffka, Kurt: "On the Structure of the Unconscious". *The Unconscious: A Symposium*. Ed. by E. Dummer. New York: Knopf, 1929. P. 43.

conscious as a systematic concept is not synonymous with the non-conscious. Rather does the existence of an unconscious presuppose the existence, potential or actual, of a conscious. The movements of a stone are not called unconscious, whereas those of an amoeba might be.... Why do we call this something unconscious? Because it is part of a mind, not of matter". We have here very clearly the mutual dependence of the two properties, which have in common the fact that they are properties of mind. And mind is essentially something structured, whereas the "non-conscious" has a different, or no, structure.

The interpretation of the conscious mind as a pregnant, relatively late arising Gestalt, as a dynamic partial system in the psyche makes it possible to understand many phenomena of the collective unconscious in the light of Gestalt theory, which we cannot discuss in full here.¹⁹ Be it mentioned here only that according to this the systemic properties of the unconscious mind constitute properties of parts in reference to the psychic whole. Metzger²⁰ has shown, though, that without reference to temporal development the significance of the whole is always decisive for the parts contained in it, and further that psychic development consists predominantly (not exclusively!) in the differentiation of sub-structures and Gestalten out of the originally more unitary, less structured whole (in which for this reason the energy charges are much more mobile, as Freud has posited for the primary system). This lends confirmation to Jung's theory of the priority and decisive significance of the collective unconscious, and not less of the collective unconscious mind.

We return now to the question already discussed as to why and under what conditions a content of the unconscious can become conscious and recall that we found the explanation by a mere change of intensity insufficient. We have, to be sure, mentioned Jung's assertion, "A complex would not be such at all if it did not possess a certain, even a considerable, affective intensity", and have expressed our agreement with it subsequently from the viewpoint of Gestalt theory, but we have raised an objection against its continuation, which reads, "One

¹⁹ Cf. in this regard the author's "Gestalt, Symbol und Archetypus". *Schweizerische Zeitschrift für Psychologie*. Bd. V, Hef. 2 (1946).

²⁰ Metzger, W.: *Psychologie*, p. 303—312.

might expect that this energy would automatically force the complex into consciousness, in short, that the power of attraction contained in it must perforce draw conscious attention. (Fields of power attract one another mutually!)" The objection consisted therein that "conscious attention" is either a mere surcharge of libido and thus meaningless, or that it must be regarded as bound to the ego, and that this theory consequently presupposes the other, which we have been unable to accept, of relation to the ego that is sensed as such by the ego as a necessary condition of the consciousness of psychic contents. We could add also Metzger's very carefully elaborated refutation of the traditional theories of attention from the standpoint of Gestalt psychology in Chapter IV, Section 5 of his *Psychologie* but must renounce this for reasons of space. It remains to consider whether a spontaneous attraction between the conscious and the unconscious really takes place as Jung affirms in the sentence, "Fields of power attract one another mutually". In the first place we should like to limit the applicability of this sentence, corresponding to the physical parallels that Jung evidently had in mind, to fields of force with opposite signs. We are not acquainted with any instances in which fields of force with like signs attract one another. This behavior of fields of force or charges of energy is in physics as in psychology a polar phenomenon. Such phenomena are not treated expressly in Gestalt psychology and indeed are hardly mentioned, although they can be inferred from the principle of isomorphism and the field concept. We recall, though, that Gestalt psychology, although it does not speak of polar properties, is well acquainted with states of tension between various structures, partial systems, and partial Gestalten in the field and is fond of describing such states of tension as mutual attraction or repulsion. Such tensions, and accordingly also such effects at a distance, occur only within a field, only in or between systems, on which account we may expect to find them only in the conscious mind or the unconscious mind, not in the conscious or the unconscious, in so far as these regions extend beyond those systems. Therefore we can only now attempt the solution of the question put, after we have learned something about the systems in question. We can easily conceive that through the integration into the conscious mind of a structure previously in

the unconscious such an alteration in the Gestalt character and consequently in the libidinal charge, or such an alteration in the positional value of the same structure can take place that the sign too becomes altered, in other words, that the previously unconscious structure now becomes conscious. But how does the tension arise, and what effects the integration?

If we will make the mutual attraction of the opposite poles alone responsible for the tension, then we shall have to explain why the conscious and the unconscious do not become wholly mixed up. One ground for this is repression, as Freud observed. This is, though, as Jung²¹ clearly shows, no sufficient ground in all cases, for "it does not take into account those other cases in which material of the unconscious, not capable in itself of consciousness, is formed into a content carrying a high energetic intensity, but remaining unable to come to consciousness at all, or doing so only with great difficulty. In such a case the conscious attitude, far from being hostile to the unconscious content, would be most favorable toward it, . . ." He sees the difficulty in a lack of associations to the new content that is to be raised into the conscious. The associations are unable to entice the conscious attention, which lends consciousness to the contents. At this point one must inquire how the associations or "bridges of reference", as Jung also calls them, which are meant to pave the way for the relations to a content of the unconscious, can arise in the direction in question when no relations exist already, unless it be by pure chance? For the possibility of their being directed by any awareness of the goal is lacking. Even if we insist on operating with associations we are obliged to assume other, primary, so-called factors of coherence, which are effective without any consciousness and direct the associations. As such Metzger²² names among others, "the identity or similarity of color, form, or impressiveness of the elements, the spatial and temporal contiguity or contact, the symmetrical position, the enclosure by a contour, in addition thereto empirically acquired collective dispositions", and we add: the relevance or meaningful relation. That Metzger is speaking here of properties of visual objects need not disturb us, for the same Gestalt principles retain their validity unaltered in all realms

²¹ *Contributions to Analytical Psychology*, p. 10, fn. 1.

²² *Psychologie*, p. 99.

of the psyche. Besides these factors of coherence it is the needs and the field tensions in general, the total structure of the field that determines the union of structures and their integration into a more comprehensive system. "But if", Metzger continues, "the objective qualities are regarded not as the immediate causes of the formation of certain connections, but only as enticements, as motives for attention, and this latter as the solely and exclusively effective synthesizing and structuring force, then one comes to a whole series of untenable consequences.... Some of the most important may be named briefly. 1. Everything (not only some things!) regarded collectively would have to form a behavioral unit. 2. Everything not regarded collectively, and consequently everything unregarded, could be present or given to us only as a manifold of disconnected elements. That holds e.g. for the entire content of the usually unregarded peripheral regions of the visual field, above all though for the latent memory traces inaccessible to the conscious 3. To perceive a whole would have to be more difficult and fatiguing than to perceive its elements; in fatigue and disturbances of all kinds a dissolution into elements would have to be expected". The same holds, with only a change of sign, when one proceeds from the theory that places the unanalyzed stream of consciousness at the beginning and ascribes all segregation and differentiation to attention. When we make use of the factor of attention and of the association theory we thus land in confusion, while the working of Gestalt factors suffices in itself to explain the re-structuring of the field and likewise the reversal of poles in respect to its contents, their becoming conscious or unconscious, and their integration into the respective systems.

VII. THE EGO AND "CONSCIOUSNESS"

We have encountered the ego repeatedly in our review of psychological theories, now as a condition of, now as conditioned by "consciousness". Although it does not belong, strictly speaking, to our theme, it is related to it so closely that we shall now pay brief consideration to it before closing.

The psychoanalytic theory of the ego has undergone so many transformations and is a matter of such controversy among

psychoanalysts themselves that a separate treatise would be required in order to do justice to it theoretically, while a judgment of it on an empirical basis is possible only to one with an experience in practical psychoanalysis which the author as an analytical psychologist does not possess. We shall content ourselves therefore with letting Fenichel¹ speak for the whole psychoanalytic school, his account being the most recent. "Mental phenomena are to be regarded as the result of the interplay of forces pressing respectively toward and away from motility. The organism is in contact with the outside world at the beginning and at the end of its reaction processes, which start with the perception of stimuli and end with motor or glandular discharge. Freud looks at the mental apparatus as modelled after an organism floating in water. Its surface takes up stimuli, conducts them to the interior, whence reactive impulses surge to the surface. The surface is differentiated gradually with respect to the functions of stimulus perception and discharge. The product of this differentiation becomes the 'ego'.... The ego develops abilities with which it can observe, select, and organize stimuli and impulses: the functions of judgment and intelligence.... It.... changes the primary process into the secondary process". According to this, the ego becomes differentiated under the pressure of external necessity as an organ of abstract behavior. We have heard (p. 16) that the ego and consciousness, the id and unconsciousness cannot be simply coordinated, and we have heard too (p. 44) that "consciousness comes into being at some point in the process of systematization" sketched in the quotation above. We now read further and hear that "this process depends on the ability to utilize memories. Memory traces are remnants of perceptions; they apparently arise on a second level below that of the perceptions themselves. The ego broadens out from the layer of these memory traces". Furthermore,² "The origin of the ego and the origin of the sense of reality are but two aspects of one developmental step.... The concept of reality also creates the concept of the ego. We are individuals inasmuch as we feel ourselves separate and distinct from others". Now, "reality" in the Freudian sense means not simply tangibility, but the ineluctable object-

¹ Loc. cit., p. 15-18.

² Fenichel, loc. cit., p. 35.

ive necessities of a world not made for the individual's pleasure. The apprehension of reality in this general sense requires as a rule the abstract attitude, although in many instances an objectively adequate reaction does come to pass on the basis of the concrete. For the abstract attitude memories are essential as an instrument of comparison. Concepts and words as signs for concepts are developed as further instruments, which make possible "trial actions", experiments as it were, with a minimum expenditure of energy. The ego thus forms conscious concepts, among them the "concept of reality", for consciousness as a quality is already present, as Fenichel himself concedes. A further step is taken when this concept of reality is applied in the way of abstract behavior to the ego itself and the concept of the ego results. That is, self-consciousness results, and we realize that the course of Fenichel's reasoning supports James' contention and ours that consciousness is by no means necessarily always consciousness of self.

A danger lies here in the practically universal tendency to confuse consciousness as a quality, as simple, concrete awareness or "acquaintance-with", with "consciousness" as "knowledge about", as an abstract knowledge of "reality". Because the ego often does serve as an organ of abstract behavior, and because such behavior probably is more often conscious than not, the ego, in spite of Fenichel's warning, is equated by many writers, albeit inconstantly, with "consciousness",³ or else consciousness is made a function of the ego, as by Bleuler. Apart from the theoretical untenability of such a proposition, which has been exposed in the foregoing chapters, it is disproved by analytical experience. How often do we not encounter dreams in which the dreamer is in no least doubt that the subject of the dream is "himself", but in which the subject is transformed out of all recognition from the usual "I". The sense of identity is basic and not to be disputed. Since the *alter ego* of the dream does occur within the conscious, it would be possible to assert that the ego in all its aspects was exclusively conscious if analysis did not succeed regularly in demonstrating that the same *alter ego* existed as an unconscious complex with unmistakable ego-character outside the dream. We repeat: neither the

³ Thus Brun (loc. cit., p. 292) goes so far as to write: "Consciousness, i.e. the ego finally perceives....".

ego nor abstract behavior is restricted to the conscious. But is the ego always an instrument or organ of abstract behavior, be this conscious or unconscious? This seems questionable, for "egoistic" behavior usually strikes us as the very opposite of abstract. Further reflection shows that, concrete though it often is, it can be abstract too, as is the case in a cold and calculating egoism. Behind the calculated behavior lie frequently very concrete motives. This leads to a question of basic importance in the consideration of abstract behavior, viz. *abstract from what?* Not only have Goldstein and Scheerer admitted that there are very different degrees of abstractness in behavior, but we now recognize anew that the same behavior that appears abstract from one viewpoint may be concrete from another, just as James has emphasized that what imposes as mere "acquaintance-with" on one level may already be equivalent to "knowledge-about" on a less exacting one. The egoist's disposition of the objects and forces that subserve his aims may be entirely abstract, but his appropriation of them to these aims is ruthlessly concrete from a social point of view. The paradox becomes both more marked and more significant when we call to mind that one of the most striking and common characteristics of abstract behavior, as Goldstein has noted explicitly, is the ability "to detach our ego from the outer world", i.e. to *abstract from the ego* when dealing with things about us.

The answer to the question: abstract from what? may be put generally as: abstract from the immediate configurational and demand characters of the given stimuli. Here it is necessary to note two things. 1. Such abstraction is only possible in experience through reference to other stimuli, or other aspects of the same stimuli. Both the frame of reference and the stimuli referred may be of varying extent topologically, and this in turn determines the level and extent of the resulting abstract behavior. 2. The stimuli treated abstractly do not vanish, but change their behavioral aspect. We do not abstract from the stimuli as such, but from certain aspects of them. So it is when the ego deals abstractly in the beginning with stimuli from without or within as a measure of adjustment to their conflicting demands, but so it is no less when we "abstract from the ego", as said above, and deal abstractly with the new configurational aspects that the stimuli have gained, following Gestalt laws, as a result of their

new organization in and elaboration by the ego. And so it is again when we treat the ego itself abstractly, having apprehended fresh aspects of it and of its relations to other contents. The ego is still there and is "detached" only in a limited sense. Thus we see both in simple perceptual configurations in the ego, and in the total personality structure that comprehends it, a series of systems or Gestalten, in which the one is partial to the other, and in which the superordinate Gestalt furnishes the indispensable structural basis for the abstract attitude toward the subordinate. As the ego constitutes a kind of center of gravity or nucleus of organization for the subordinate system, so does Jung's "Self"⁴ for the superordinate one; and there is no particular reason for assuming that the succession of ever more comprehensive systems is therewith terminated. Many Eastern philosophies, which are quite as much psychologies as philosophies, allow us indeed to suspect that it is not. The Self is then the "we" that deals abstractly with the ego, as the ego is the "we" that deals abstractly with percepts and ideas. The extent and degree of our abstract behavior in any given situation then depends on the entire dynamic configuration both of our personality and of the situation itself.

Why such a structure as the ego or — by inference — the Self is necessary for abstract behavior we have seen: it provides a psychological and probably also a temporal frame of reference that makes possible distinction, analysis, comparison, generalization, and the like processes. The analysis of Bleuler's theory of consciousness has afforded us some insight into its nature and the conditions of its origin. We saw there, and have been able to support this view by other evidence, that consciousness

⁴ The word "Self" in Jung's special sense, not to be confused with the ego, is written here with a capital. "I discriminate", he says (*Psychological Types*, p. 540), "between the ego and the Self, since the ego is only the subject of my consciousness, while the Self is the subject of my totality; hence it also includes the unconscious psyche. In this sense the Self would be an (ideal) factor which embraces and includes the ego." For this reason Jung can also write (*Prolegomena to a Science of Mythology*): "The 'Self' as the opposite pole, as the absolute 'other' of the world is the *conditio sine qua non* for the knowledge of the world and the consciousness of subject and object. It is that being psychically different that makes consciousness possible at all" — consciousness, we would add, as an awareness of distinctions, as "knowledge-about", as an abstract attitude towards things.

and unconsciousness could be presumed to exist as soon as any inhomogeneity arose in the psychophysical (not merely the perceptual) field, but that memory and an awareness of distinction and relation depended on the existence not merely of inhomogeneity, but of discontinuity. Now, a more than merely punctate discontinuity is the condition for the differentiation of the perceptual field into figure and ground. When the stimuli arising from the spontaneous activity of our own psyche are perceived, the perceptual field is isomorphic with the psychophysical field, as in external perception also; and when we perceive the ego among such stimuli, i.e. are self-conscious, it is perceived usually as the figure.⁵ The boundaries of this behavioral ego or *anschauliches Ich*, inconstant though they certainly are, correspond to a sensed discontinuity in our internal perception. How does such a discontinuity arise? It cannot be referred to the boundary between the conscious and the unconscious, for we have every reason to believe that in the beginning the transition between these is so gradual that it would be misleading to speak of a "boundary" at all. Nor can it be referred to the boundary between the unconscious mind and the conscious mind, the concrete and the abstract system, for these systems themselves remain still to be organized. Rather must we conclude, following now Freud's hint, that the first discontinuity arises from the collision of incompatible stimuli, representations (among them the archetypes) of internal drives or external objects.⁶ When the incompatibility is founded on the nature of the external stimuli, it comes and goes with these stimuli, but when it is founded on the spontaneous drives it is far more enduring, as the ego is the most enduring of the complexes or systems in the total field. Because most, if not all, such incompatibilities require abstract behavior for their solution (in so far as a solution is possible at all or is not rendered superfluous by Jung's "transcendental function" through the mediation of an archetype), the ego

⁵ The very important exceptions to this rule we have treated in another place, as well as the problem of the ego's figure-ground relationship in general. Cf. Bash, K. W.: "Gestaltpsychologische Grundlagen der Jung'schen Einstellungstypen". *Acta Psychologica* (to appear shortly).

⁶ The external objects themselves can be just as much representations of drives as the internal stimuli, the primary reaction to them being based wholly on their demand character.

becomes in the course of development that "place" at which the transition between concrete and abstract behavior occurs and becomes localized topologically upon the boundary between the concrete and the abstract system, having a share in both. Since the concrete system is predominantly unconscious, the abstract (for reasons which we have seen) predominantly conscious, the ego likewise has a share in both the unconscious and the conscious. Certain pathological cases excepted, its conscious portion is the most strongly differentiated and organized sub-system within the conscious mind, for which reason we encounter it in self-conscious internal perception in a figure-ground relationship with the conscious mind. That we can experience directly no such relationship between the conscious and the unconscious, or between the conscious mind and the unconscious mind, or between the ego and either the unconscious or the unconscious mind is obvious from the unconsciousness of the latter.

The foundation of the ego upon *inner*, more or less enduring incompatibilities, which confers upon it its typically permanent character, explains why it is possible to experience discriminations between outer stimuli without any consciousness of the ego itself. Lammer's experience already quoted is a case in point. Here inhomogeneity and discontinuity in the perceptual field (the light spot in the grey fog) were experienced without any awareness of the ego. This does *not* show, however, that no ego existed during this time. Koffka is carefull to say that "*phenomenally* quite a long period of time passed without an Ego". As he later points out, awareness of the ego entered only after several inhomogeneities and discontinuities (grey fog, light spot, feeling of cold discomfort) were present in the field and — as we may now conclude — had necessitated a still more abstract attitude than that involved in the discrimination between light and dark, or light and cold. The different sensory qualities, he surmises, required to be referred to a common center, the ego, in order that they might be organized into a meaningful perceptual whole.

From the above we can understand better now Jung's paradoxically sounding sentence:⁷ "The ego complex is a content of the conscious as well as a condition of consciousness". It is a

⁷ *Psychological Types*, p. 540.

condition of the systemic character of the conscious mind, but a content of the conscious. According to its nature as a surface or boundary function between the two systems (the analogy to semi-permeable cell membranes is hardly to be avoided) it must present two typically different faces. Jung has described the one turned toward the conscious mind, mediating between it and the ego, as the persona, that turned toward the unconscious mind and performing the same function in this direction as the anima or animus.⁸ This boundary character of the ego expresses itself not only functionally, but also behaviorally, for Koffka⁹ has called attention to the fact that the behavioral ego is the typical plane of reference for behavioral judgments of "in front" and "behind".

Goldstein¹⁰ has pointed out that in the schizophrenic "the demarcation between the outer world and his ego is more or less suspended or modified", and further¹¹ that deficient figure-ground formation is characteristic alike of schizophrenic and organic patients. These two traits in combination lead to the insufficient differentiation of the ego as a figure. This easily observed symptom of schizophrenia, in which the vaguely defined "I's" often come to the fore and recede again with bewildering rapidity, lends confirmation to our hypothesis that the differentiation of the ego rests upon the incompatibility of drives and concrete reactions, for it is perhaps the most striking characteristic of affective dissociation in schizophrenia, a "primary symptom" according to Bleuler's classification, that the most conflicting and contrary behavior tendencies exist side by side, simultaneously in regard to the same object, with but slight or no evidence of tension between them. The discontinuity between them, apparent enough to the observer, seems not to exist in the patient's behavioral field, and therefore the organization into figure and ground remains deficient. So does the ego, and for the same reason.

In conclusion I wish to thank Prof. C. G. Jung for his interest

⁸ Jung, C. G.: "The Relation between the Ego and the Unconscious", *passim*. *Two Essays on Analytical Psychology*. Translated by H. G. and C. F. Baynes. London: Bailliere, Tindall and Cox, 1928.

⁹ *Principles of Gestalt Psychology*, p. 322.

¹⁰ "Methodological Approach", p. 23.

¹¹ *Ibid.*, p. 32ff.

and for his profoundly stimulating ideas. He is not to be held responsible, however, for any opinions here expressed, except where they are expressly designated as his own. Thanks are also due to Prof. R. Meili for valuable criticisms and suggestions.

VIII. SUMMARY

1. *Summary*

Through an analysis of the views propounded by leading writers of the schools of psychoanalysis, analytical psychology, and Gestalt psychology concerning "consciousness" and "the unconscious" we are able to distinguish three main senses in which these terms are wont to be used, namely as: 1. a quality of certain psychic contents or processes, of the object as well as of the subject; 2. that portion of the psyche whose contents are characterized by the aforementioned quality, a region defined in the topological sense by consciousness or unconsciousness; 3. a psychic system coinciding to a certain degree, but by no means necessarily coextensive with the foregoing and set off from the remainder of the psyche by certain systemic properties. We have proposed to designate the first with the terms "consciousness" and "unconsciousness" (as qualities), the second with "the conscious" and "the unconscious" (as topological regions), and the third provisionally with "the conscious mind" and "the unconscious mind" (as systems). Further analysis showed that consciousness was unnecessary for explaining the systemic properties of the conscious mind, which were discovered to possess a noteworthy similarity with what Goldstein has studied experimentally and designated as "abstract behavior". The peculiarities of the unconscious mind also correspond in a high degree to Goldstein's "concrete behavior".

The fact that both conscious and unconscious psychic contents of nearly all kinds could be found without essential alterations in both systems led to the hypothesis, suggested by the analogy to electric fields and other physical phenomena, that consciousness and unconsciousness could be regarded as inherent polar qualities of psychic energy. This hypothesis found confirmation in the field theory of Gestalt psychology on the one hand and in Jung's theory of psychic complementariness on the other.

Employing Gestalt concepts of dynamic organization in the concrete and abstract systems, it was then possible to account for a series of phenomena observed in depth psychology, in dreams, and in the analysis of the unconscious mind. The insufficiency of all theories of consciousness based on the ego could be exposed, and finally the ego was shown to be a relatively stable member of a series of ever more comprehensive Gestalten that provide frames of reference for ever more advanced degrees of abstract behavior.

2. Zusammenfassung

Durch eine Analyse der von führenden Vertretern der Psychoanalyse, der Analytischen Psychologie und der Gestaltpsychologie dargelegten Ansichten über das „Bewusstsein“ und das „Unbewusste“ gelang es, dreierlei Sinne, worin diese Ausdrücke hauptsächlich verwendet zu werden pflegen, zu unterscheiden, als da sind: 1) eine Eigenschaft gewisser psychischer Inhalte oder Vorgänge, und zwar sowohl des Objekts wie auch des Subjekts; 2) der Teil der Psyche, dessen Inhalte durch die soeben erwähnte Eigenschaft jeweils ausgezeichnet sind, im topologischen Sinne ein durch die Bewusstheit bzw. Unbewusstheit gekennzeichnete Bezirk; 3) ein psychisches System von mehr oder weniger gleicher Ausdehnung wie das Vorhergehende, aber keineswegs notwendig damit zusammenfallend, welches von der übrigen Psyche durch gewisse Systemeigenschaften unterschieden ist. Wir haben vorgeschlagen, das Erste mit den Ausdrücken „Bewusstheit“ bzw. „Unbewusstheit“ (als Eigenschaften) zu bezeichnen, das Zweite mit „dem bewussten“ bzw. „dem Unbewussten“ (als topologischen Bezirken), das Dritte vorläufig mit „Bewusstsein“ bzw. „Unbewusstsein“ (als Systemen). Eine weitere Analyse zeigte, dass die Bewusstheit zur Erklärung der Systemeigenschaften des Bewusstseins nicht erforderlich sei, welches selbst eine bemerkenswerte Ähnlichkeit mit dem aufwies, was Goldstein experimentell untersucht und als „abstraktes Verhalten“ bezeichnet hat. Die Eigentümlichkeiten des Unbewusstseins entsprechen ebenfalls weitgehend dem „konkreten Verhalten“ Goldsteins.

Die Tatsache, dass sowohl bewusste wie auch unbewusste psychische Inhalte beinahe jeder Gattung ohne wesentliche Veränderung sich innerhalb beider Systeme antreffen lassen, führte

zu der durch die Analogie mit elektrischen Kraftfeldern und weiteren physikalischen Erscheinungen angeregten Hypothese, dass Bewusstheit und Unbewusstheit als innewohnende Pol-eigenschaften psychischer Energie zu betrachten seien. Diese Hypothese fand eine Bestätigung einerseits in der Feldtheorie der Gestaltpsychologie, anderseits in Jungs Theorie der psychischen Gegensätzlichkeit bzw. Ergänzung. Mit der Hilfe gestaltpsychologischer Begriffe der dynamischen Organization des abstrakten bzw. konkreten Systems wurde es dann möglich, Erklärungen für eine Reihe der in der Tiefenpsychologie, in den Träumen und in der Analyse des Unbewussten beobachteten Erscheinungen zu finden. Die Unzulänglichkeit aller auf das Ich gründenden Bewusstseinstheorien konnte dargetan werden, und schliesslich konnten wir das Ich als ein verhältnismässig stabiles Glied in einer Reihe stets umfassenderer Gestalten deuten, welche Bezugspunkte für stets höhere Grade abstrakten Verhaltens liefern.

THE SUBJECTIVE DURATION OF TIME-INTERVALS. II

THE INFLUENCE OF ORDER IN THE ESTIMATION OF DURATION OF TWO SUCCESSIVE INTERVALS

by

DR. C. OTTO ROELOFS and PROF. DR. W. P. C. ZEEMAN

If one wants to study the influence of different circumstances on the apparent duration of certain time-intervals this can only take place by comparing two successive intervals in which the circumstance to be investigated is present in an unequal way. For it is a fact that in a simultaneous comparison the circumstances are, as a matter of course, always equal.

If, however, one compares the apparent duration of two successive intervals, there is always a factor present which may influence the result and might disturb our conclusions about that circumstance on which our investigation was directed. This factor is the *order* of the interval. It is namely quite conceivable that also in circumstances which for the rest are perfectly equal the first interval is estimated differently from the second.

This unequal estimation of first and second interval might again be different in connection with the break between the two intervals, with the objective duration of the intervals and with the contents of the intervals. Should the contents be of significance to the measure in which the order makes its influence felt, we may still ask ourselves whether this significance holds good for the first interval only, for the second interval only, or for both intervals.

We shall try to answer all these questions in the following investigation. The knowledge of the influence of the order will not only preserve us from committing errors in judging the influence of other factors or circumstances, but this knowledge may also contribute to our insight in the origination of the subjective perception of duration.

First investigation-series.

The first investigation-series is an investigation as to the influence of the break on longer intervals filled with a continuous perception of light. The interval was marked by the duration of exposition of a luminous square projected on the wall in a twilit room. The objects used for the purpose are two squares situated beside each other and directly adjacent, having a surface of 11.5 times 11.5 cm²; these are projected after one another, with an intermediate break of different length. The subject (Z) sits at a 2 meters' distance. The experiment is every time repeated so often till the subject has formed a judgment.

The exposition-time of one of the squares amounted to 3200 σ ; that of the other square was altered each time and in irregular order amounted to: 3840, 3520, 3200, 2880 and 2560 σ . The square with the constant duration of exposition was every time, during 50 successive observations either the left or the right square. The alternate duration of exposition concerned the left as often as the right square and the first-projected as often as the last-projected square. The square shown first stood as often to the left as to the right. The break between the two expositions amounted to 6400, 3200, 1600, 800, 400 and 0 σ . At each break 200 observations were made, so that in this series 1200 observations were made in all. In the survey given us in table X, it is therefore the series 1 up to and including 6, which were made use of for this investigation. Table I.

From this investigation-series we might learn therefore:

1. the influence of being projected left or right.
2. the influence of being exposed first or last, i.e. of order.
3. the influence of the length of the break.

Little or nothing of the influence under 1 has become apparent, reason why we shall pass it over in silence.

Of the influences under 2 and 3 table I gives a complete survey.

This survey teaches us at a single glance that under all circumstances offered the duration of the last interval is estimated as being longer, and that, therefore, the order appears to be of importance. Yet there is also a clear correlation between the objective proportions and the certainty with which the last

T A B L E I

Objectively	SUBJECTIVELY							Certainty-percentage
	Break:	6400 σ	3200 σ	1600 σ	800 σ	400 σ	0 σ	To-gether
First Int. 640 σ longer: 40 3840—3200 ; 3200—2560	First Int. longer	0	0	0	0	0	1	1
	Last Int. longer	8	5	4	11	7	2	37
	Equally long	32	35	36	29	33	37	202
First Int. 320 σ longer: 40 3520—3200 ; 3200—2880	First Int. longer	0	0	0	0	0	0	0
	Last Int. longer	13	11	6	17	15	5	67
	Equally long	27	29	34	23	25	35	173
First and last Int. equal: 40 3200—3200	First Int. longer	0	0	0	0	0	0	0
	Last Int. longer	15	21	20	23	20	13	112
	Equally long	25	19	20	17	20	27	128
Last Int. 320 σ longer: 40 3200—3520 ; 2880—3200	First Int. longer	0	0	0	0	0	0	0
	Last Int. longer	24	31	25	27	25	22	154
	Equally long	16	9	15	13	15	18	86
Last Int. 640 σ longer: 40 3200—3840 ; 2560—3200	First Int. longer	0	0	0	0	0	0	0
	Last Int. longer	32	29	29	39	30	30	189
	Equally long	8	11	11	1	10	10	51
Totally	First Int. longer	0	0	0	0	0	1	1
	Last Int. longer	92	97	84	117	97	72	559
	Equally long	108	103	116	83	103	127	640

Certainty-percentage

SUBJECTIVELY

Break:

Objectively

Totally

36/240=15%
last Int. longer67/240=27.9%
last Int. longer112/240=42.5%
last Int. longer154/240=63.3%
last Int. longer189/240=78.7%
last Int. longer558/1200=46.5%
last Int. longer

exposition is estimated as being longer. This increases the reliability of the data.

The percentage of cases in which the estimation as being longer or shorter is, as may be assumed, with certainty concerned with the objective proportions, we would call the "certainty-percentage".

About the computation of this certainty-percentage we want to remark the following: When among 1200 observations the first interval is estimated as being longer in one case and the last in 559 cases, it is clear that the last interval is generally seen as being longer. The one case in which the first interval was seen as being longer, was brought about by chance, incalculable factors; but these factors might just as well have caused the last interval to be seen as being longer. Thus there remain 558 cases which, with fairly great certainty, we may ascribe to the objective proportions and the physiological reactions on them, so that from these we have computed the number of certain cases. $\left(\frac{558}{1200} = 46.5\% \right)$

If the objective duration of the first interval is lengthened, the percentage of the cases in which the second interval seems to be of longer duration, becomes slighter, so regularly that it is also ascertainable in how far the objective duration of the first object should be lengthened until this percentage has fallen to 0 and the last object subjectively seems to be of equal duration with the first.

We have also tried to give expression to the *sensitivity* to a change of the objective proportions in a number. Let us take as an example the experiment-series No. 5, with the break of 400. In 97/200 of the expositions the second interval was of apparently longer duration; i.e. in 48.5 %. Now our table teaches us that in objective lengthening of the first interval, starting from — 640 to — 320, to 0, to + 320, up to + 640, the frequency with which an apparently longer duration of the last interval is ascertained, very regularly falls from 30/40 to 25/40, 20/40, 15/40, 7/40. The amount, the steepness of this fall (resp. rise) may serve as a standard for the *sensitivity* to objective changes of duration. The lengthening of the objective duration of the first interval with 20 % (640 σ) of the total duration of expo-

sition (3200σ) causes the frequency, resp. the certainty-percentage to decrease with, on an average, $10.75/40 = 26.875 \%$.

If the first and the last interval are objectively equal, the last interval is in 20 out of 40 cases estimated as being longer; if the last interval is objectively 640σ (i.e. 20 %) longer, it is in 30 out of 40 cases estimated as being longer, an increase of 10 in 40; indication that the objective lengthening of 20 % is with certainty recognized in 10 out of 40 cases. If the last interval was 320σ (10 %) longer it is in 25/40 of the cases estimated as being longer; the increase, therefore, only amounts to 5 in 40, indication that the objective lengthening of 10 % in 5 out of 40 cases — one of 20 %, therefore is, as may be assumed, in 10 out of 40 cases —, perceived with certainty. If the first interval is 320σ (i.e. 10 %) longer, the number of cases in which the second is estimated as being longer, falls to 15/40, i.e. with 5/40; a decrease which, in an objective lengthening of 20 %, may be assumed to amount to 10/40. The table shows that in objective lengthening of the first interval of 640σ (20 %), it is only in 7 cases that the second interval is estimated as being longer; a decrease of 20 to 7, i.e. of 13 in 40 cases.

We derive, therefore, from our table four values, 10, 10, 10, 13, from which we find an average of 10.75 in 40 cases, or 26.9 %. This number informs us about the certainty with which an objective change of 20 % makes itself felt in the estimation of duration. We have made use of this number, of this change in the certainty-percentage, as a standard for the sensitivity to objective changes in duration.

On the ground of this the total number of 97/200 cases in which the second interval seems to be of longer duration may be expected to be reduced to 0, when the objective duration of the first interval is lengthened by $97/2/26.875 \times 20 \% = 36.1 \%$; i.e. by 36.1 % of $3200 \sigma = 1155 \sigma$. So if the first interval amounts to $3200 + 577.5 = 3777.5$ and the second interval to $3200 - 577.5 = 2622.5$, this condition is fulfilled and both intervals will be estimated as being equal. The apparent shortening of the first interval with respect to the second then amounts to 30.6 %.

Thus we found for the different breaks:

Break: 6400σ ; equal estimation with 1st interval: 3712σ and 2nd interval: 2698σ ; i.e. an apparent shortening of the first interval of 27.6 %.

Break: 3200 σ ; equal estimation with 1st interval: 3588 σ and 2nd interval: 2812 σ ; i.e. an apparent shortening of the first interval of 21.6 %.

Break: 1600 σ ; equal estimation with 1st interval: 3541.3 σ and 2nd interval 2858.7 σ ; i.e. an apparent shortening of the first interval of 19.2 %.

Break: 800 σ ; equal estimation with 1st interval: 3824 σ and 2nd interval: 2576 σ ; i.e. an apparent shortening of the first interval of 32.6 %.

Break: 400 σ ; equal estimation with 1st interval: 3777.5 σ and 2nd interval: 2622.5 σ ; i.e. an apparent shortening of the first interval of 30.6 %.

Break: 0 σ ; equal estimation with 1st interval: 3488.5 σ and 2nd interval 2911.5 σ ; i.e. an apparent shortening of the first interval of 16.5 %.

If we want to compute an average from these different values, we must leave out the apparent shortening in case of a break of 0, because here very special factors seem to play a part, as may not only be inferred on the ground of the unusually low value of 16.5 %, but also from subjective perceptions of the subject. The average out of the further 5 values is 26.3 %. The oscillations found round this average are too irregular to bring them into connection with the length of the break. Certainly the apparent shortening is no stronger in case of longer breaks; it is rather the opposite that takes place.

For lack of a real break (break = 0) the number of cases in which the last exposition is estimated as being longer, becomes constantly smaller. The latter is easily to be accounted for from the apparent movement perceived under the circumstances, in which the beginning of the second projection is localized at the place of the first projection and only after this shifts to its own place. Owing to this the apparent duration of the first projection gains somewhat in length and that of the second loses somewhat in length.

Not in all experiment-series was the correlation between the apparent duration of the expositions and the objective proportions as regular as in the example chosen with a break of 400.

The average sensitivity in the whole experiment-series amounts to 34.1. In the different experiment-series put side by side we found the following sensitivities:

28.7 with a break of 6400; 40 with a break of 3200;
39.4 with a break of 1600; 30 with a break of 800;
26.9 with a break of 400; 39.4 with a break of 0.

The sensitivity is also dependent on the psychological attitude. In case one is very cautious in pronouncing one's judgment, the sensitivity is slight, but the regularity of the results great (with break of 400 σ); if one is less cautious, the sensitivity apparently becomes great, but the regularity of the results slighter (with break of 1600 σ).

The results of this first investigation-series are therefore:

1. with intervals of on an average 3200 σ , filled with a continuous perception of light, the first interval is estimated as being 26.3 % shorter than the second;
2. with intervals of on an average 3200 σ , filled with a continuous perception of light, the duration of the break within very ample limits (400—6400 σ) has little or no influence on the subjective perception of duration. Only when the break becomes very small, the difference in estimation between first and second interval proves somewhat less great. We can explain this from the peculiar localization of the second object in the beginning of the projection with this short break.

Second investigation-series.

The second investigation-series purposed an investigation as to the influence of the break in case of shorter intervals filled with a continuous perception of light.

The exposition-time of one of the squares amounted to 400 σ . The exposition-time of the other square was: 480, 440, 400, 360 and 320 σ . The break between the two expositions amounted to: 1600, 800, 400, 200 and 0 σ . With every break 200 observations were made, so that this investigation-series contains 1000 observations.

For the rest the installation and the course of the investigation were quite the same as those of the first investigation-series. For this second investigation-series the experiment-series 10 up to and including 14, found in survey-table X, did duty. With the longer exposition-times in the first investigation-series there was practically no difference between the subjective duration of left and right object. With these shorter expositions, on the

TABLE II

Objectively	SUBJECTIVELY						Certainty-percentage
	Break:	1600 σ	800 σ	400 σ	200 σ	0 σ	To- gether
First Int. 80 σ longer: 40 480-400; 400-320	First Int. longer	27	25	22	20	24	118
	Last Int. longer	0	0	0	0	0	0
	Equally long	13	15	18	20	16	82
First Int. 40 σ longer: 40 440-400; 400-360	First Int. longer	22	18	11	18	15	84
	Last Int. longer	0	0	0	0	2	2
	Equally long	18	22	29	22	23	114
First and last Int. equal: 40 400-400	First Int. longer	7	4	6	9	13	39
	Last Int. longer	4	0	5	0	0	9
	Equally long	29	36	29	31	27	152
Last Int. 40 σ longer: 40 400-440; 360-400	First Int. longer	2	0	0	2	7	11
	Last Int. longer	5	4	16	4	1	30
	Equally long	33	36	24	34	32	159
Last Int. 80 σ longer: 40 400-480; 320-400	First Int. longer	0	0	1	0	4	5
	Last Int. longer	17	19	25	8	3	72
	Equally long	23	21	14	32	33	123
Totally	First Int. longer	58	47	40	49	63	257
	Last Int. longer	26	23	46	12	6	113
	Equally long	116	130	114	139	131	630

118/200=59%
first Int. longer82/200=41%
first Int. longer30/200=15%
first Int. longer19/200=9.5%
last Int. longer67/200=33.5%
last Int. longer144/1000=14.4%
first Int. longer

contrary, the duration of the right object seemed to be estimated as being somewhat longer. This must perhaps be ascribed to the fact that with these expositions of short duration the eyes are not fully directed to the object, so that the left object remains depicted more on the right retinal half and the right object more on the left retinal half.

Our chief purpose also this time was, however, once more to get to know the influence of being exposed first or last (the order) and of the objective duration of the intermediate break.

Table II gives a survey of the results obtained.

If with the longer duration of exposition in the first investigation-series the duration of the *last* exposition was estimated as being longer in the vast majority of cases, with the shorter duration of exposition in this second investigation-series we see that the duration of the *first* exposition is on an average estimated as being longer (c.f. the numbers $257-113=144$ in 1000, i.e. with a certainty-percentage of 14.4 %).

Just as with the longer exposition-times we also now find a very distinct correlation between the objective proportions and the certainty with which one of the two intervals is estimated as being longer. With an objective change of 80, i.e. 20 %, the certainty-percentage changes on an average with 48.4 %. Just as in the first investigation-series we have also this time expressed the sensitivity as to the perception of objective proportions in numbers; these numbers are the changes in the certainty-percentage in case of a change in the objective proportions with 20 %. (in this case 80 σ). We then find with the different breaks the following values:

58.7 with a break of 1600 σ ; 55 with a break of 800 σ ; 62.5 with a break of 400 σ ; 42.5 with a break of 200 σ ; and 23.1 with a break of 0 σ . From this we see that the sensitivity in case of a break of 400 σ and more is as good as constant, but that in case of a slighter break it considerably decreases.

From this sensitivity and from the number of cases in which the estimation as being longer of the one interval surpassed that of the other interval, we have in the same way as in the first investigation-series computed the objective difference which must exist between the two intervals, in order that they be estimated as being equal, as well as the apparent shortening of the subjectively shortest interval.

Thus we found for the different breaks:

Break 1600 σ ; equal estimation with first interval: 389.1 σ and second interval: 410.9 σ , i.e. an apparent shortening of the second interval of: 5.3 %.

Break 800 σ ; equal estimation with 1st interval: 391.2 σ and 2nd interval: 408.7 σ ; i.e. an apparent shortening of the second interval of: 4.3 %.

Break 400 σ ; equal estimation with 1st interval: 401.9 σ and 2nd interval: 398.1 σ ; i.e. an apparent shortening of the first interval of: 0.9 %.

Break 200 σ ; equal estimation with 1st interval: 382.6 σ and 2nd interval: 417.4 σ ; i.e. an apparent shortening of the second interval of: 8.3 %.

Break 0 σ ; equal estimation with 1st interval: 350.7 σ and 2nd interval: 449.3 σ ; i.e. an apparent shortening of the second interval of: 21.9 %.

Here, therefore, we see in contradistinction to the results of our first experiment-series a distinct influence of the break, for we remark that in decrease of the break from 1600 to 400 σ , the estimation of the second exposition as being shorter, or the estimation of the first exposition as being longer, gradually becomes a little less. With a break of 400 σ there is really no longer any question of under-estimation or over-estimation owing to the order of the exposition. With the breaks of from 400 to 0 σ the estimation of the second interval as being shorter, or of the first interval as being longer, rather strongly increases again.

This time a new factor seems to turn up, cancelling and opposing the influence of the decrease of the break. We are of opinion that here the same factor is to be recognized which, in our first experiment-series, we made responsible for the fact that, failing a real break, the number of cases in which the last interval was estimated as being longer, was smaller in number. Here, indeed, we have the same phenomenon, in increasing quantity an apparently shorter duration of the second interval.

It is once more the apparent movement which makes itself felt here and owing to which the last exposition is estimated as being too short. The first square does not disappear, but apparently shifts its position, which means that the last square on its appearance is localized in the place of the first square.

The duration of the apparent shifting is not fully counted, resp. taken up, (in equal measure) in the apparent duration of the last exposition, which, especially with these shorter times of exposition, is an important factor. If, namely, we should evade the apparent movement by projecting the squares far apart, the second square appears in its own place and the last exposition is estimated as being considerably longer, as we learned from a former investigation with an exposition-time of 420 σ and a break of 210 σ ; viz. first interval longer: 89 = 11 %; second interval longer: 252 = 31.5 %; equal; 459 = 57.5 % with a computed apparent shortening of the first interval of 8 %. So, on evasion of the apparent movement, with breaks of from 400 to 0 σ , the apparent shortening of the first interval will probably gradually increase.

The chief results of this second investigation-series are therefore:

1. In two intervals of short duration of about 400 σ , filled up with a continuous perception of light, the last interval is estimated as being shorter with intermediate breaks of more than 400 σ .
2. This apparent shortening of the second interval with a break of more than 400 σ , increases within certain limits with the length of the break: 4.3 % with a break of 800 σ ; 5.3 % with a break of 1600 σ .
3. With a break of about 400 σ , the first and the second interval are estimated as being almost equal in case of these expositions of short duration.
4. With breaks of less than 400 σ , the second interval is probably over-estimated in case of these expositions of short duration, if the factors, which also evoke an apparent movement, are avoided.
5. If the factors calling up the apparent movement are not avoided, the second interval will be estimated as being all the shorter in proportion as, with a shorter break, the apparent movement comes more to the fore.

The sensitivity as to the perception of objective differences of time is almost constant with breaks of from 400 to 1600 σ , but proves to fall considerably in case of smaller breaks. It is highly probable that also this phenomenon is connected with the aforementioned apparent movement.

Third investigation-series.

The third investigation-series aimed at getting to know the influence of the objective duration of the intervals filled up with a continuous perception of light. To get to know the influence of the objective duration on the significance of the order and with respect to the estimation of duration in general, it will be necessary to leave all other factors as much unaltered as possible. Here, however, we immediately have to do with a difficulty. One of the factors is namely the break between the two intervals. Should one keep equal the absolute value of the break in the different values for the duration of the intervals now, or should one keep equal the proportion between the duration of the break and that of the interval? In order to avoid the difficulty of a choice, we have divided this investigation into a series in which the absolute duration of the break remained equal: series A, and a series in which the relative duration of the break remained equal: series B. The installation and the course of the investigation were on the whole equal to those in the preceding investigation-series.

For series A the experiment-series 3, 7, 8 and 10 out of survey-table X were made use of. The break between the two intervals always amounted to 1600 σ . The duration of the intervals was as follows:

- a. Duration of exposition of the one square: 3200 σ and that of the other square: 3840, 3520, 3200, 2880 and 2560 σ .
- b. Duration of exposition of the one square: 1600 σ and that of the other square: 1920, 1760, 1600, 1440 and 1280 σ .
- c. Duration of exposition of the one square: 800 σ and that of the other square: 960, 880, 800, 720 and 640 σ .
- d. Duration of exposition of the one square: 400 σ and that of the other square: 480, 440, 400, 360 and 320 σ .

The influence of being projected to the left or to the right could not be ascertained.

Table III shows us the influence of the duration of exposition in an unambiguous way.

The computed certainty-percentage only has a very relative value here, the estimation being so clearly dependent on the duration of exposition and the average losing in importance therefore. Nevertheless we see here, too, a distinct correlation

TABLE III

Objectively	SUBJECTIVELY						Certainty-percentage
	Interval:	3200 σ	1600 σ	800 σ	400 σ	To- gether	
First Int. 20% longer or Last Int. 20% shorter	First Int. longer	0	1	25	27	53	43/200 = 21.5% first Int. longer
	Last Int. longer	4	4	2	0	10	
	Equally long	36	35	13	13	97	
First Int. 10% longer or Last Int. 10% shorter	First Int. longer	0	0	8	22	30	17/200 = 8.5% first Int. longer
	Last Int. longer	6	5	2	0	13	
	Equally long	34	35	30	18	117	
First and last Int. equally long: 40	First Int. longer	0	0	5	7	12	30/200 = 15% last Int. longer
	Last Int. longer	20	16	2	4	42	
	Equally long	20	24	33	29	106	
Last Int. 10% longer or First Int. 10% shorter	First Int. longer	0	0	0	2	2	66/200 = 33% last Int. longer
	Last Int. longer	25	24	14	5	68	
	Equally long	15	16	26	33	90	
Last Int. 20% longer or First Int. 20% shorter	First Int. longer	0	0	0	0	0	111/200 = 55.5% last Int. longer
	Last Int. longer	29	38	27	17	111	
	Equally long	11	2	13	23	49	
Totally	First Int. longer	0	1	38	58	97	147/800 = 18.4% last Int. longer
	Last Int. longer	84	87	47	26	244	
	Equally long	116	112	115	116	459	

between the objective proportions of time and the computed certainty-percentage, which speaks for the reliability of the results.

Some numbers in the separate compartments are somewhat improbably high or low, which is to be ascribed to too small a number of observations for obtaining those numbers, as conjointly they supply a very good average.

Just as in the preceding investigation-series we have also now computed for every experiment-series the sensitivity as to perception of objective changes in time. Making this computation in the way described above, we found:

39.4 with a duration of exposition of 3200 σ ; 45.6 with a duration of exposition of 1600 σ ; 56.2 with a duration of exposition of 800 σ ; and 58.7 with a duration of exposition of 400 σ . So the sensitivity increases when the intervals become smaller; i.e. on the intervals to be compared becoming smaller, the recognizable differences are not only absolutely smaller, but also relatively smaller.

Now if we also compute, in the way indicated before, the apparent shortening of the first or second interval, we find:

Duration of exposition 3200 σ ; equal estimation with 1st interval: 3541.3 σ and 2nd interval: 2858.7 σ ; i.e. an apparent shortening of the first interval of 19.2 %.

Duration of exposition: 1600 σ ; equal estimation with 1st interval: 1750.8 σ and 2nd interval: 1449.2 σ ; i.e. an apparent shortening of the first interval of 17.2 %.

Duration of exposition: 800 σ ; equal estimation with 1st interval: 806.4 σ and 2nd interval: 793.6 σ ; i.e. an apparent shortening of the first interval of 1.6 %.

Duration of exposition: 400 σ ; equal estimation with 1st interval: 389.1 σ and 2nd interval: 410.9 σ ; i.e. an apparent shortening of the second interval of 5.3 %.

With a constant break of 1600 σ between two intervals, the over-estimation of the second interval gradually decreases when these intervals become shorter, to pass into an under-estimation of the second interval with intervals lasting between 800 and 400 σ .

With intervals of something more than 700 σ and a break of 1600 σ both intervals, in agreement with the objective proportions will be estimated as being equal. This change-over from

over-estimation into under-estimation, takes place in case of a duration of exposition reminding one of the apparent movement.

If a short time after each other, but at a slight distance from each other: two squares are, for instance, projected on the wall, the first square disappears or the second square does not appear in its place, but an apparent movement from the place of the first exposition to that of the second exposition is observed.

Should the interval between the two expositions become greater, the movement-phenomenon becomes less clear, while, in our experience, the last remnant of an apparent movement disappears with an interval of about 800 σ .

The apparent movement points to a certain link between the stimuli of the first and the second object, manifesting itself in the identification of the objects.

With a duration of exposition of less than 800 σ we may also expect an analogous link between the beginning and the end of that exposition.

Now the rather long break of 1600 σ in the observation just reported must prevent us from identifying this observation with that of the apparent movement from the first to the second exposition.

This need, however, not hinder us from considering the critical duration of 700 σ of the continuous interval of a single exposition, coming to the fore from our experiments, related to the "interval", so important in experiments concerning apparent movement; resp. to the break between two expositions.

The perception of apparent movement, just as the perception of real movement itself report us at one single moment the concrete happenings of some duration, in which both the past and the present are incorporated. In this way different elements of the objective "time" become united into the subjective perception, the latter acquiring a new dimension of its own and representing a direct perception of time-relations, which is perceived as a change or as a movement, and which is losing more or less the quality of duration.

This can only happen with such processes as occur within a period of 700 σ . (at the utmost 800—900 σ). For this junction the velocity of the movement probably is of no importance. It may be, that if the velocity approaches zero, i.e. the object does not move, the beginning and the end of the exposition nevertheless

become united if only the objective duration of the total exposition remains within the mentioned limits (700—800 σ).

With a filled-up interval of longer duration, longer than 800 σ the link between beginning and end loses in importance, and the contents of the interval will, in some way or other, co-operate in the estimation of duration.

We shall, therefore, also in view of the following results, have to trace whether with a sufficiently long break (1600 σ), the second exposition will be estimated as being longer, if owing to the longer duration of exposition the contents will become of chief importance and the second exposition will be estimated as being shorter, if owing to the shorter duration of exposition the link between initial and final stimulus comes to the fore.

Provisionally this series A has taught us the following:

1. With intervals of from 3200—400 σ , filled up with a continuous perception of light and separated by a break of 1600 σ , the second interval is over-estimated with a duration of both intervals for more than 700 σ and under-estimated with a duration of both intervals for less than 700 σ .
2. With a duration of both intervals of more than 1600 σ , the over-estimation of the second interval only slowly increases proportionally.
3. Between a duration of 1600 σ and 700 σ of both intervals, the over-estimation of the second interval rapidly decreases.
4. Between a duration of 700 σ and 400 σ of both intervals, the under-estimation of the second interval still increases.
5. The sensitivity as to the perception of objective differences of time with shorter intervals within wide limits (3200—400 σ) is both absolutely and relatively greater than with longer intervals.

Now in passing on to the result of series B, we must mention that this was obtained from the experiment-series 2, 7, 9 and 12, found in survey-table X.

Installation and course of the investigation were quite identical to those of series A; only the objective duration of the intermediate break was now equal to the objective duration of the constant interval. No influence as to being projected to the left or to the right appeared to the present.

The results of this series B are drawn up in Table IV in such

a way that from this the influence of the duration of exposition is obvious. Also in this series B the second interval is estimated as being longer in proportion as the objective duration of the intervals is longer.

The very regular way in which the average certainty-percentage noted down in the last column increases or decreases with the change in the objective proportions is quite beautifully demonstrated. In case one of the intervals has become 10 % longer or shorter, the certainty-percentage changes with about 20 %.

The sensitivity with regard to the perception of objective differences in time, computed in the above-mentioned way, was for the different experiment-series: 40 with a duration of exposition of 3200 σ ; 45.6 with a duration of exposition of 1600 σ ; 63.1 with a duration of exposition of 800 σ ; and 62.5 with a duration of exposition of 400 σ . The sensitivity with the duration of exposition of 800 σ is somewhat unexpectedly large; for the rest we see that also in this series the sensitivity is greater in proportion as the intervals are smaller so that not only absolutely smaller differences, but also relatively smaller differences are sooner recognized. Table IV.

If now we also compute the apparent shortening of the first interval in the way indicated before, we find:

Duration of exposition: 3200 σ ; equal estimation with 1st interval 3588 σ and 2nd interval: 2812 σ ; i.e. an apparent shortening of the first interval of 21.6 %.

Duration of exposition: 1600 σ ; equal estimation with 1st interval 1750.8 σ and 2nd interval: 1449.2 σ ; i.e. an apparent shortening of the first interval of 17.2 %.

Duration of exposition: 800 σ equal estimation with 1st interval 813.9 σ and 2nd interval: 786.1 σ ; i.e. an apparent shortening of the first interval of 3.4 %.

Duration of exposition: 400 σ ; equal estimation with 1st interval 401.9 σ and 2nd interval: 398.1 σ ; i.e. an apparent shortening of the first interval of 0.9 %.

It is clear that also in this series the under-estimation of the first interval or the over-estimation of the second interval decreases in proportion as the objective duration of interval and break becomes less. With an objective duration of a little under

TABLE IV

Objectively	SUBJECTIVELY					Certainty-percentage
	Break and Interval	3200 σ	1600 σ	800 σ	400 σ	To-gether
First Int. 20% longer or Last Int. 20% shorter	First Int. longer	0	1	26	22	49
	Last Int. longer	5	4	0	0	9
	Equally long	35	35	14	18	102
First Int. 10% longer or Last Int. 10% shorter	First Int. longer	0	0	8	11	19
	Last Int. longer	11	5	2	0	18
	Equally long	29	35	30	29	123
First and last Int. equally long: 40	First Int. longer	0	0	0	6	6
	Last Int. longer	21	16	4	5	46
	Equally long	19	24	36	29	108
Last Int. 10% longer or First Int. 10% shorter	First Int. longer	0	0	1	0	1
	Last Int. longer	31	24	14	16	85
	Equally long	9	16	25	24	74
Last Int. 20% longer or First Int. 20% shorter	First Int. longer	0	0	0	1	1
	Last Int. longer	29	38	37	25	129
	Equally long	11	2	3	14	30
Totally	First Int. longer	0	1	35	40	76
	Last Int. longer	97	87	57	46	287
	Equally long	103	112	108	114	437

40/200=20%
first Int. longer1/200=0.5%
first Int. longer40/200=20%
last Int. longer84/200=42%
last Int. longer128/200=64%
last Int. longer211/800=26.4%
last Int. longer

400 σ there is no longer any question of under-estimation or over-estimation and the intervals are perceived in agreement with the objective proportions.

This is certainly not caused by the break becoming smaller as, on comparison with series A, series B shows us that it is just exactly the becoming shorter of the break, which counteracts the estimation of the second interval as being shorter. The same was, indeed, already ascertained in the course of the second investigation-series, and has been mentioned in the summary of the results under 2.

In series A we found the change-over from over-estimation into under-estimation of the second interval with a duration of 700 σ and a break of 1600 σ ; in series B we find this change-over with a duration of interval of 400 σ and a break of 400 σ . The following explanation of this phenomenon, the difference between 700 σ in series A and 400 σ in series B, i.e. the influence of the shorter break, seems quite plausible to us. We were speaking all the time of break, but this break is really also a time-interval limited by the final stimulus of the first interval and the initial stimulus of the second interval. In case of a shorter break a stronger link between the stimuli limiting this break will come into being; owing to this the break is apparently shortened and the second interval lengthened accordingly. We see the same in rhythmification of sound-stimuli; if 3 sound-stimuli are given, which are rhythmified by some inequality or other, the isolation of the first or last stimulus will be all the greater in proportion as the link between the two other stimuli is more intensive. As the break in the experiments reported is a so-called vacant interval, this will even strengthen the link between the limiting stimuli. As the second interval is filled with a continuous perception of light, this will rather counteract the link between the limiting stimuli. Afterwards we shall see that the influence of the break in this respect indeed becomes slighter, if we convert the break into a filled-up interval and the intervals we want to compare are so-called vacant intervals.

In this investigation we have indeed experiment-series with intervals of 400 σ and a break of 200 and of 0 σ , and in those cases we see the apparent shortening of the second interval increase again, though this had to be ascribed to the peculiar

localization occurring with apparent movement. In a former investigation, though, with filled-up intervals of 420 σ and a vacant break of 210 σ , in which the apparent movement was avoided by means of projecting the squares farther apart, we found an over-estimation of the second interval of 8 %.

Series B of this investigation has taught us therefore:

1. With all intervals filled-up with a continuous light-perception of from 3200—400 σ and break between the intervals equal to the duration of those intervals, the first interval is always estimated as being shorter.

2. The under-estimation of the first interval in the above-mentioned times of from 3200—400 σ is all the stronger in proportion as the duration of the intervals is longer.

3. The apparent shortening of the first interval only begins to decrease strongly with a duration of exposition smaller than 1600 σ .

4. We are of opinion that with intervals and break of 400 σ we may assume a place of change-over from over-estimation of the second interval into under-estimation of the second interval, though this under-estimation is counteracted by the short vacant break.

5. The sensitivity as to the perception of objective differences in time is both absolutely and relatively greater with shorter intervals than with longer intervals. This holds good within ample limits. (3200—400 σ).

Fourth investigation-series.

In the preceding investigation-series we have already remarked that we were always comparing two intervals filled-up with contents to which we had specially to pay attention. The break between these two intervals was a so-called vacant interval, in which nothing particular drew the attention and in which the eyes were fixed in twilight on a bare wall.

This fourth investigation-series is an investigation as to the influence of a filled-up break between two so-called vacant intervals of longer duration.

These so-called vacant intervals were obtained by now projecting the two squares of the preceding investigation-series constantly on the wall, but interrupting this projection during a definite time. The two squares were at a very slight distance

from each other. The time of interruption is called the vacant interval; this interval was therefore limited by the disappearance of one of the squares and the re-appearance of this square. During the break both squares were present therefore.

The interruption of the exposition of one of the squares amounted to 3200 σ . The duration of interruption of the other square was: 3840, 3520, 3200, 2880 and 2560 σ . The varying duration of interruption concerned the left square as often as the right one, and the first interval as often as the second. The first interruption concerned the left square as well as the right one. The break between the two interruptions or intervals was 3200, 1600, 400 and 0 σ . This investigation-series is therefore comparable to the first investigation-series, if from this we eliminate the results with a break of 6400 and 800 σ .

At every break 200 observations were made, so that in this series 8000 observations were made in all.

From survey-table X the experiment-series 15, 16, 17 and 18 were made use of for this investigation.

No more than in the first investigation-series did any influence appear of the interruption of the left or right square.

The influence of the order of the intervals and of the duration of the break can best be read off from Table V.

From this we see that, just as in the first investigation-series, also with the vacant intervals, the last interval is estimated as being longer or the first as being shorter. Here, too, there exists a highly satisfactory correlation between the certainty-percentage and the objective proportions of time. Yet we also remark that with the filled-up intervals over-estimation of the second interval was on an average stronger than with these vacant intervals.

On computing the sensitivity as to the recognition of objective time-proportions in the well-known way, we found the following:

37.5 with a break of 3200 σ 31.9 with a break of 1600 σ ; 40.0 with a break of 400 σ and 33.7 with a break of 0 σ . The break apparently has little or no influence on the sensitivity; so that we think ourselves entitled to assume an average of 35.8. With the filled-up intervals of 3200 σ this average was 36.4 with the analogous breaks; we can, therefore, also ascertain herewith that with intervals of 3200 σ their being vacant or filled-up has no

T A B L E V

Objectively	SUBJECTIVELY						Certainty-percentage
	Break:	3200 σ	1600 σ	400 σ	0 σ	To- gether	
First Int. 640 σ longer: 40 3840-3200 ; 3200-2560	First Int. longer	2	0	0	9	11	1/160=0.6% last Int. longer
	Last Int. longer	1	6	4	1	12	
	Equally long	37	34	36	30	137	
First Int. 320 σ longer: 40 3520-3200 ; 3200-2880	First Int. longer	0	0	0	1	1	25/160=15.6% last Int. longer
	Last Int. longer	7	9	9	1	26	
	Equally long	33	31	31	38	133	
First and last Int. equal: 40 3200-3200	First Int. longer	0	0	0	0	0	51/160=31.9% last Int. longer
	Last Int. longer	16	17	13	5	51	
	Equally long	24	23	27	35	109	
Last Int. 320 σ longer: 40 3200-3520 ; 2880-3200	First Int. longer	0	0	0	1	1	83/160=51.9% last Int. longer
	Last Int. longer	22	21	27	14	84	
	Equally long	18	19	13	25	75	
Last Int. 640 σ longer: 40 3200-3840 ; 2560-3200	First Int. longer	0	0	0	0	0	114/160=71.2% last Int. longer
	Last Int. longer	29	33	32	20	114	
	Equally long	11	7	8	20	46	
Totally	First Int. longer	2	0	0	11	13	274/800=34.2% last Int. longer
	Last Int. longer	75	86	85	41	287	
	Equally long	123	114	115	148	500	

influence on the sensitivity as to the perception of objective proportions of time.

On computing the apparent shortening of the first interval also in the above-mentioned way, we find:

Break 3200 σ ; equal estimation with 1st interval: 3511.4 σ and 2nd interval: 2888.5 σ ; i.e. an apparent shortening of the first interval of 17.7 %.

Break 1600 σ ; equal estimation with 1st interval: 3631.7 σ and 2nd interval: 2768.3 σ ; i.e. an apparent shortening of the first interval of 23.8 %.

Break 400 σ ; equal estimation with 1st interval: 3540 σ and 2nd interval: 2860 σ ; i.e. an apparent shortening of the first interval of 19.2 %.

Break 0 σ ; equal estimation with 1st interval: 3342.2 σ and 2nd interval: 3057.8 σ ; i.e. an apparent shortening of the first interval of 8.5 %.

Just as with the filled-up intervals we see that the apparent shortening with breaks of 400 σ and more oscillates round an average. Only with a break of 0 σ we see that the over-estimation of the second interval is much slighter. Here, too, we think this must be brought into connection with the apparent movement. The square the exposition of which was first interrupted, appears in the place of the square about to disappear now, only to take up its own place afterwards. Owing to this the first interval is estimated as being longer and the last interval as being shorter than would be the case without this peculiar change in localization. For the rest it makes the impression that with very long breaks the over-estimation of the second vacant interval is perhaps somewhat less than with shorter breaks. At any rate the difference is only very small, so that we think that, as average apparent shortening for vacant intervals of 3200 σ , with breaks of from 400—3200 σ , we are justified in assuming a percentage of 20.2. With the filled-up intervals of 3200 σ this average percentage was 23.8. So with vacant intervals the apparent shortening of the first interval is somewhat smaller; they behave, therefore, like filled-up intervals of objectively shorter duration. This is in agreement with the fact formerly found by us that vacant intervals within certain limits are estimated as being shorter than equally long filled-up intervals.

The results of the fourth investigation-series are therefore:

1. With so-called vacant intervals averaging 3200 σ the first interval is estimated as being shorter than the second; the apparent shortening of the first interval in that case amounts to 20.2 %.

2. The under-estimation of the first interval with so-called vacant intervals of about 3200 σ is somewhat slighter than the under-estimation with so-called filled-up intervals of the same duration.

3. The break between the two intervals proves to be of little importance as to over-estimation or under-estimation of one of the two intervals. Perhaps with shorter breaks the over-estimation of the second interval or the under-estimation of the first interval is somewhat greater.

4. If the break approaches 0 σ , the over-estimation of the second interval may decrease as a consequence of the experimental arrangement. This has to be ascribed to relations of localization, which also give us the apparent movement.

5. The sensitivity as to the perception of objective changes in time is almost equally great with the so-called vacant and filled-up intervals of about 3200 σ .

Fifth investigation-series.

The fifth investigation-series is an investigation as to the influence of the objective duration of a filled-up break with so-called vacant intervals of short duration.

The installation was again the same as in the preceding investigation-series. The duration of interruption of one of the squares amounted to 400 σ . The duration of interruption of the other square was: 480, 440, 400, 360 and 320 σ . The varying duration of interruption concerned the left object as often as the right one, and the first interval as often as the last. The first interruption concerned the left square as often as the right one. The break filled-up with light-perception, between the intervals to be judged, amounted to 1600, 400, and 0 σ . At every break 200 observations were made, so that in all 600 observations were made in this series. They are the experiment-series 19, 20 and 21 from the survey-table X, which were made use of for this investigation.

Just as in the second investigation-series with the filled-up

TABLE VI

Objectively	SUBJECTIVELY					Certainty-percentage
	Break:	1600 σ	400 σ	0 σ	To- gether	
First Int. 80 σ longer: 40 480-400 ; 400-320	First Int. longer	39	33	24	96	96/120=80% first Int. longer
	Last Int. longer	0	0	0	0	
	Equally long	1	7	16	24	
First Int. 40 σ longer: 40 440-400 ; 400-360	First Int. longer	18	17	17	52	52/120=43.3% first Int. longer
	Last Int. longer	0	0	0	0	
	Equally long	22	23	23	68	
First and last Int. equal: 40 400-400	First Int. longer	5	11	11	27	18/120=15% first Int. longer
	Last Int. longer	2	1	6	9	
	Equally long	33	28	23	84	
Last Int. 40 σ longer: 40 400-440 ; 360-400	First Int. longer	0	1	8	9	22/120=18.3% last Int. longer
	Last Int. longer	10	9	12	31	
	Equally long	30	30	20	80	
Last Int. 80 σ longer: 40 400-480 ; 320-400	First Int. longer	0	0	4	4	63/120=52.5% last Int. longer
	Last Int. longer	27	29	11	67	
	Equally long	13	11	25	49	
Totally	First Int. longer	62	62	64	188	81/600=13.5% first Int. longer
	Last Int. longer	39	39	29	107	
	Equally long	99	99	107	305	

intervals of short duration, the interruptions of the square on the right side were also here estimated as being somewhat longer than those of the square on the left side.

The influence of the order of the intervals and of the contents of the break we find noted down in Table VI.

Here, too, we are once more struck by the very good correlation between the results obtained and the objective proportions. With every change in duration of one of the intervals with 10 %, the certainty-percentage changes with 33.1 %. With the *filled-up* intervals of short duration this was only 23.5 %; the sensitivity as to the perception of objective differences in time is therefore much greater with the *vacant* intervals.

Further we may notice that the numbers we computed as values for the sensitivity are rather high and that: 76.2 with a break of 1600 σ ; 70.0 with a break of 400 σ ; and 45.6 with a break of 0 σ . Both with the vacant and with the filled-up intervals of short duration we find a strong decrease in sensitivity, if the break approaches 0. If we eliminate these values with a break of 0 σ , the average sensitivity is consequently 73.1 with vacant intervals of about 400 σ and 60.6 with filled-up intervals of 400 σ . This is possibly connected with the fact that vacant intervals are estimated as being shorter and that with shorter intervals we meet with a greater relative sensitivity. One might also say that these results show that the filling-up of the interval works disturbingly on the judgment of the duration of the interval, so that presumably the estimation of duration is founded on a judgment of the link between the limiting stimuli.

Also with the short vacant intervals we can in the above-mentioned way make an estimation of the apparent shortening of the second interval. Then we come to the following results:

Break 1600 σ ; equal estimation with 1st interval: 393.9 σ and 2nd interval: 406.0 σ ; i.e. an apparent shortening of the second interval of 3.1 %.

Break 400 σ ; equal estimation with 1st interval: 393.4 σ and 2nd interval: 406.5 σ ; i.e. an apparent shortening of the second interval of 3.2 %.

Break 0 σ ; equal estimation with 1st interval: 384.6 σ and 2nd interval: 415.3 σ ; i.e. an apparent shortening of the second interval of 7.4 %.

For lack of a break the same phenomenon, we have met with

again and again, occurs, viz. that the first interval is estimated as being somewhat longer or the second interval as being somewhat shorter owing to localization-relations manifesting themselves with the apparent movement.

A comparison with the second investigation-series shows us that the filled-up and vacant intervals behave somewhat differently with respect to the influence of the break. With the short filled-up intervals there existed the inclination, in case of the shorter vacant break, to estimate the second interval as being less shortened (leaving very short breaks with apparent movement out of consideration). We do not meet with this phenomenon in case of short vacant intervals with shorter filled-up breaks. The great difference is especially met with in case of the break of 400 σ . In our opinion the explanation is obvious. The break is also an interval limited by two stimuli. With a vacant, short break the link between the limiting stimuli will be rather great to the detriment of the second interval, especially when the link between the limiting stimuli of the second interval, owing to its contents, is not so great as might be expected. With a filled-up break, on the contrary, the link between the limiting stimuli will be slighter and this all the more so, if the link between the limiting stimuli of the intervals to be judged is rather strong, as there are so-called vacant.

The fifth investigation-series has taught us the following therefore:

1. With vacant intervals of short duration of about 400 σ the last interval is estimated as being shorter. This apparent shortening amounts to about 3.1 %.
2. The apparent shortening of the second exposition with filled-up intervals of short duration is somewhat stronger with longer breaks; with shorter breaks on the contrary it is distinctly slighter.
3. Not any influence of the intermediate break with vacant intervals of short duration was demonstrable with breaks of from 400—1600 σ .
4. With breaks of very short duration and for lack of a break the second interval is underestimated considerably more strongly, which is connected with localization-phenomena in the manifestation of apparent movement.
5. The sensitivity as to the perception of objective differences

in time is greater with vacant intervals of short duration than with filled-up intervals of short duration.

Sixth investigation-series.

This investigation-series purposes to learn *the influence of the objective duration of so-called vacant intervals.*

To this end we have only made investigations with intervals of 3200 σ and 400 σ . The breaks between the two intervals amounted to 1600 σ , 400 σ and 0 σ . As with a break of 0 σ the results are strongly influenced by localization-phenomena in the apparent movement, and as thus a new factor was introduced, we have not taken into consideration the results with a break of 0 σ , with regard to a study of the influence of the objective duration of the intervals. As we have further noticed in the fourth and fifth investigation-series that the objective duration of the break filled up with light-perception has little or no influence, we have composed the results in case of the breaks of 1600 σ and 400 σ , so that for this investigation, both with intervals of 3200 σ and with those of 400 σ , 400 observations could be made use of in each case. It is the results of the experiment-series 16, 17, 19 and 20 of survey-table X, which have been worked out for the purpose. In order to be able to compare these results with those of filled-up intervals, those of the filled-up intervals with a break of 1600 and 400 σ were also taken, i.e. the experiment-series 3, 5, 10 and 12. In table VII the results are placed side by side.

As the judgment of the duration of time is strongly influenced by the objective duration of the intervals, the computed average certainty-percentage only has relative value. Nevertheless it shows us the correct correlation between this certainty-percentage and the objective changes in time, which is a standard for the reliability of the data.

Besides we see from this that sensitivity as to the perception of objective differences in time with the vacant intervals is considerably greater than with the filled-up intervals, which especially finds expression with the intervals of 400 σ . Now if, just as before, we also compute here a value for the sensitivity as to perception of objective differences in time, we find: 35.9 for vacant intervals of 3200 σ ; 73.1 for vacant intervals of 400 σ ; 33.1 for filled-up intervals of 3200 σ ; and 60.6 for filled-up intervals

TABLE VII

Objectively	Interval:	Subjectively with vacant intervals				Subjectively with filled up intervals			
		3200 σ	400 σ	To- gether	Certainty %	3200 σ	400 σ	To- gether	Certainty %
First Int. 20% longer or Last Int. 20% shorter	First Int. longer	0	72	72	62/160 = 38.7%	0	49	49	38/160 = 23.7%
	Last Int. longer	10	0	10	first Int. longer	11	0	11	first Int. longer
	Equally long	70	8	78		69	31	100	
First Int. 10% longer or Last Int. 10% shorter	First Int. longer	0	35	35	17/160 = 10.6%	0	33	33	12/160 = 7.5%
	Last Int. longer	18	0	18	first Int. longer	21	0	21	first Int. longer
	Equally long	62	45	107		59	47	106	
First and last Int. equally long: 80	First Int. longer	0	16	16	17/160 = 10.6%	0	13	13	36/160 = 22.5%
	Last Int. longer	30	3	33	last Int. longer	40	9	49	last Int. longer
	Equally long	50	61	111		40	58	98	
Last Int. 10% longer or First Int. 10% shorter	First Int. longer	0	1	1	66/160 = 41.2%	0	2	2	69/160 = 43.1%
	Last Int. longer	48	19	67	last Int. longer	50	21	71	last Int. longer
	Equally long	32	60	92		30	57	87	
Last Int. 20% longer or First Int. 20% shorter	First Int. longer	0	0	0	121/160 = 75.6%	0	1	1	100/160 = 62.5%
	Last Int. longer	65	56	121	last Int. longer	59	42	101	last Int. longer
	Equally long	15	24	59		21	37	58	
Totally	First Int. longer	0	124	124	125/800 = 15.6%	0	98	98	155/800 = 19.4%
	Last Int. longer	171	78	249	last Int. longer	181	72	253	last Int. longer
	Equally long	229	198	427		219	230	449	

of 400 σ . Consequently we see the above confirmed here. With shorter intervals the sensitivity is greater than with longer intervals; with vacant intervals the sensitivity is greater than with filled-up intervals, which chiefly holds good for the intervals of short duration.

On computing the shortening of the first or second interval we find:

Vacant interval 3200 σ ; equal estimation with first interval: 3580.6 σ and 2nd interval: 2819.3 σ ; i.e. an apparent shortening of the first interval of 21.3 %.

Vacant interval 400 σ ; equal estimation with first interval: 393.7 σ and 2nd interval: 406.3 σ ; i.e. an apparent shortening of the second interval of 3.1 %.

Filled-up interval 3200 σ ; equal estimation with 1st interval: 3637.1 σ and 2nd interval: 2762.8 σ ; i.e. an apparent shortening of the first interval of 24.0 %.

Filled-up interval 400 σ ; equal estimation with 1st interval: 395.7 σ and 2nd interval: 404.3 σ ; i.e. an apparent shortening of the second interval of 2.1 %.

Just as with the intervals filled up with a continuous perception of light we meet with the so-called vacant intervals with the phenomenon that with the intervals of longer duration (3200 σ) the second interval is estimated as being relatively longer and with the intervals of shorter duration (400 σ) the second interval is estimated as being relatively shorter.

In judging the intensity of two successive stimuli there exists the general inclination to estimate the intensity of the last stimulus as being greater. What is the cause now that in judging two intervals of short duration the last interval is estimated as being shorter? Perhaps the solution must be looked for in the following direction. With intervals of longer duration the contents of the interval preponderate. The more the contents preponderate, the longer the interval will seem. With the second interval the contents will preponderate even more strongly and thus this interval will be estimated as being longer. With intervals of shorter duration the limiting stimuli preponderate. In proportion as these limiting stimuli preponderate more, the interval will be estimated as being shorter. In the second interval the stimuli will seem more intensive; consequently the limiting stimuli will preponderate even a little more strongly

and owing to this the interval will be estimated as being even shorter.

This hypothesis also makes it clear that with the filled-up intervals of longer duration the over-estimation of the second interval is somewhat stronger than with the vacant intervals of longer duration, and that with the filled-up intervals of shorter duration the under-estimation of the second interval is somewhat less strong than with the vacant intervals of shorter duration.

It does not seem improbable to us that every change or every stimulus perceived by us and separated by objective time from a preceding change or stimulus, is perceived by us with a more or less intensive link to that preceding perception of a stimulus. The intensity of that link is our perception of duration and is, therefore, always relative in nature. We will for the moment leave out of the question what the perception of earlier or later may be founded on.

The facts supplied by this sixth investigation-series are therefore:

1. With equal so-called vacant intervals of longer duration (3200 σ) the second interval is estimated as being longer than the first.

2. With equal so-called vacant intervals of shorter duration (400 σ) the second interval is estimated as being shorter than the first.

3. The over-estimation of the second interval with intervals of longer duration is a little stronger with the filled-up intervals than with the vacant ones.

4. The under-estimation of the second interval with intervals of shorter duration is a little less with the filled-up intervals than with the vacant ones.

5. The sensitivity as to the perception of objective changes in time is considerably less with the intervals of longer duration than with the intervals of shorter duration. This holds good both for filled-up and for vacant intervals.

6. The sensitivity as to the perception of objective changes in time is greater with the vacant intervals than with the filled-up ones. With the intervals of longer duration the difference is only slight; with the intervals of shorter duration the difference is very clear.

Seventh investigation-series.

Some difference has appeared to exist in the estimation of duration of two successive intervals according as these intervals are so-called vacant or filled-up. The question rises here whether this being vacant or filled-up only has an influence on the first interval, only on the second interval or whether it has an influence on both intervals.

The purpose of this investigation-series was to find out the influence of the either or not being filled-up with intervals of longer duration. (3200 σ). We shall be able to attain this end by mutually comparing not only two vacant or two filled-up intervals, but also by comparing two intervals the first of which is filled-up and the second vacant, or the first of which is vacant and the second filled-up.

In this seventh investigation-series we have made use of intervals of 3200 σ and compared them with intervals of 3840, 3520, 3200, 2880 and 2560 σ , in the same way as also took place in the preceding investigation-series. The break between the two intervals amounted to 1600 σ or 400 σ . As the results with these two breaks scarcely differed, we have joined the results together in order to make the data more reliable by a greater number of observations.

From survey-table X the following experiment-series were used therefore: 3 with 5, 16 with 17, 22 with 23, and 26 with 27.

The results of this are shown us in Table VIII.

The correlation between the change in the certainty-percentage and the change in the objective proportions is also highly satisfactory in this case. If one of the intervals becomes 10 % longer or shorter, the certainty-percentage changes on an average with 16.5 %. This average is of somewhat more value here, as the results from all these 8 experiment-series so greatly agree.

If we compute the values for the sensitivity as to the perception of objective differences in time, in the way indicated, we find: 33.1 for the order filled-up — filled-up; 35.9 for the order vacant — vacant; 39.1 for the order vacant — filled-up; and 39.1 for the order filled-up — vacant. The average sensitivity in these experiment-series therefore amounts to 36.8.

Now if we compute, in the same way as before, the apparent shortening of the first interval, we get the following results:

TABLE VIII

Objectively	SUBJECTIVELY						Certainty-percentage
	Order:	filled up filled up	vacant vacant	vacant filled up	filled up vacant	To- gether	
Break: 1600 σ and 400 σ							
First Int. 640 σ longer: 80 3840-3200 ; 3200-2560	First Int. longer	0	0	1	4	5	31/320=9.7% last Int. longer
	Last Int. longer	11	10	6	9	36	
	Equally long	69	70	73	67	279	
First Int. 320 σ longer: 80 3520-3200 ; 3200-2880	First Int. longer	0	0	0	1	1	65/320=20.3% last Int. longer
	Last Int. longer	21	18	16	11	66	
	Equally long	59	62	64	68	253	
First and last Int. equal: 80 3200-3200	First Int. longer	0	0	1	0	1	142/320=44.4% last Int. longer
	Last Int. longer	40	30	39	34	143	
	Equally long	40	50	40	46	176	
Last Int. 320 σ longer: 80 3200-3520 ; 2880-3200	First Int. longer	0	0	0	0	0	195/320=60.9% last Int. longer
	Last Int. longer	50	48	50	47	195	
	Equally long	30	32	30	33	125	
Last Int. 640 σ longer: 80 3200-3840 ; 2560-3200	First Int. longer	0	0	0	0	0	242/320=75.6% last Int. longer
	Last Int. longer	59	65	62	56	242	
	Equally long	21	15	18	24	78	
Totally	First Int. longer	0	0	2	5	7	675/1600=42.2% last Int. longer
	Last Int. longer	181	171	173	157	682	
	Equally long	219	229	225	238	911	

Order filled-up — filled-up; equal estimation with 1st interval 3637.1 σ and 2nd interval: 2760.8 σ ; i.e. an apparent shortening of the first interval of 24.0 %.

Order vacant — vacant; equal estimation with 1st interval 3580.6 σ and 2nd interval: 2819.3 σ ; i.e. an apparent shortening of the first interval of 21.3 %.

Order vacant — filled-up; equal estimation with 1st interval 3550.2 σ and 2nd interval: 2849.8 σ ; i.e. an apparent shortening of the first interval of 19.7 %.

Order filled-up — vacant; equal estimation with 1st interval 3511.3 σ and 2nd interval: 2888.7 σ ; i.e. an apparent shortening of the first interval of 17.7 %.

This result was rather unexpected and could not quite satisfy us. The fact that the apparent shortening of the first interval with the order vacant — filled-up is greater than the order filled-up — vacant, shows that the vacant interval is estimated as being shorter than the filled-up interval. We also thought the phenomenon that the apparent shortening is greater with two filled-up intervals than with two vacant intervals, could be connected with this fact. Besides it was evident from earlier investigations, specially directed towards this end, that the vacant interval is unmistakably always estimated as being shorter than the filled-up interval. All this is, however, contrary to the fact that with the order vacant — filled-up the apparent shortening is smaller than with the order filled-up — filled-up, and also that with the order vacant — filled-up this apparent shortening is smaller than with the order vacant — vacant. The results are therefore contradictory. This contradiction demands an explanation, which we will try to give below. Meanwhile it should be observed that it does not seem excluded that this contradiction only exists in appearance and that the differences from which this conclusion was drawn, still fall within the limits of error. Eliminating a few unreliable numbers, already cancels this contradiction, as has become clear to us.

We must, however, remark that with former investigations intervals of more than 1800 σ had never been made use of and as the difference between the estimation of vacant and filled-up intervals clearly diminishes on the objective duration of the intervals becoming longer, this may certainly also have been of influence.

We shall also have to take into account an altered psychical attitude of the trial-person, who, owing to the very large number of observations he has gradually made, has learned to apply a definite standard in his judgements.

Now if we want to compute in an unprejudiced way from the results obtained in what proportion a vacant and a filled-up interval are estimated to each other with an objective duration of about 3200 σ , we may set to work as follows.

Out of the results with the order vacant — vacant we can approximately compute that 3200 σ vacant in the first interval are estimated as being equally long as 2519.6 σ vacant in the second interval; in the same way we can calculate from the results with the order vacant — filled-up that 3200 σ vacant in the first interval are estimated as being equally long as 2568.7 σ filled-up in the second interval. From this it would follow that in the second interval 2519.6 σ vacant are estimated as being equally long as 2568.7 σ filled-up, which would mean that with these long times a filled-up interval as second exposition would be

estimated as $\frac{2519.6}{2568.7} = 0.98 \times$ longer than a vacant one.

A similar computation can be made by comparing the results of the order filled-up — vacant with those of the order filled-up — filled-up. Then it appears that 3200 σ filled-up in the first interval are estimated as being equal to 2632.6 σ vacant in the second interval or to 2430.8 σ filled-up in the second interval. The influence of being vacant or filled-up would in this case be that in the second interval the filled-up one would be estimated as being $\frac{2632.6}{2430.8} = 1.08 \times$ longer.

This does not square with the value found first; if, however, we do equal justice to both values, we find that with these long intervals of 3200 σ the filled-up interval in the second place is estimated as being $1.03 \times$ longer than the vacant interval.

In a similar way we can compute the influence of the being vacant or filled-up for the first interval. If we compare the results of the order vacant — vacant, with those of the order filled-up — vacant, we find that 3200 σ vacant in the second interval are estimated as being equal to 4064.1 σ vacant in the first interval or to 3889.7 σ filled-up in the first interval, so that with these longer times a filled-up interval is estimated as being

$\frac{4064.1}{3889.7} = 1.04 \times$ longer than a vacant interval, if the first presented interval is concerned.

Finally we can still compare the results with the order vacant — filled-up with those with the order filled-up — filled-up. Then we find that 3200 σ filled-up in the second interval are apparently of as long duration as 3986.5 σ vacant or 4212.6 σ filled-up in the first interval, so that from this it would follow that, if the first interval is concerned, the filled-up one is estimated as being $\frac{3986.5}{4212.6} = 0.95 \times$ longer than the vacant one.

This value does not square with the preceding one either. If we take the average of both values, we come to the conclusion that with these long intervals it makes no difference in judging the duration whether the first interval is so-called vacant or filled-up.

The slight differences produced by the experiment-series in this investigation make it possible to compute, out of the 1600 observations on which it is founded, a reliable average for the apparent shortening of the first interval with an average duration of 3200 σ . This calculation teaches us that both intervals will be estimated as being equal, if the first interval lasts 3566.9 σ and the second interval 2833.1 σ . This means an apparent shortening of the first interval of 20.6 %.

This seventh investigation-series has therefore taught us the following:

1. With intervals of longer duration of about 3200 σ it is of little importance whether this interval is so-called vacant or filled up with visual contents.
2. Probably the filled-up intervals are estimated as being somewhat longer than the vacant intervals and probably this difference in estimation is somewhat greater for the second interval than for the first interval. The differences are, however, so slight that they hide behind the inevitable errors of observation.
3. The average apparent shortening of the first interval with times of 3200 σ amounts to 20.6 %.
4. If the change in duration of one of the intervals amounts to 20 %, this change is recognized in 36.8 % of the perceptions.

(We have called this number the sensitivity as to the perception of objective differences in time).

Eighth investigation-series.

Just as in the seventh investigation-series, also in this series filled-up and vacant intervals were directly compared with each other.

By this investigation we wanted to get well-informed about the influence of the either or not being filled up, i.e. about the contents with intervals of shorter duration. In contradistinction to the preceding series the experiments were now made with intervals of on an average 400 σ ; intervals of 400 σ had namely to be compared with intervals of 480, 440, 360 and 320 σ . The installation and the course of the investigation were quite similar to those of the preceding series. The break between the two intervals amounted to 1600 σ and 400 σ .

Out of survey-table X the experiment-series 10, 12, 19, 20, 24, 25, 28 and 29 were made use of for this investigation.

As the results with the breaks of 1600 σ and 400 σ hardly showed any difference, they were put together in order to get larger and more reliable numbers in this way.

Table IX gives us a survey of these results.

Whereas the influence of the interval being vacant or filled-up was only exceedingly slight in the preceding investigation-series, in this eight investigation-series with the short intervals this appears to be of the greatest importance. The computed average certainty-percentage has therefore only a relative value here, though it may inform us about the correlation between this certainty-percentage and the objective proportions with which we can compare the importance and reliability of the data. This correlation can indeed be called very good. In case of a change of one of the intervals with 10 %, the certainty-percentage changes on an average with 28.3 %. From this it is already evident that the sensitivity as to objective differences in time with these short intervals is relatively larger than with the longer intervals.

Now if we also compute this sensitivity for every experiment-series separately, just as we did above, we find: 60.6 for the order filled-up — filled-up; 73.1 for the order vacant — vacant; 45.3

T A B L E I X

Objectively	SUBJECTIVELY						Certainty-percentage
	Order:	filled up filled up	vacant vacant	vacant filled up	filled up vacant	To- gether	
Break: 1600 σ and 400 σ							
First Int. 80 σ longer: 40	First Int. longer	49	72	2	73	196	196/320 = 61.2% first Int. longer
480-400 ; 400-320	Last Int. longer	0	0	0	0	0	
	Equally long	31	8	78	7	124	
First Int. 40 σ longer: 40	First Int. longer	33	35	0	56	124	113/320 = 35.3% first Int. longer
440-400 ; 400-360	Last Int. longer	0	0	11	0	11	
	Equally long	47	45	69	24	185	
First and last Int. equal: 40	First Int. longer	13	16	0	47	76	40/320 = 12.5% first Int. longer
400-400	Last Int. longer	9	3	24	0	36	
	Equally long	58	61	56	33	208	
Last Int. 40 σ longer: 40	First Int. longer	2	1	0	8	11	77/320 = 24.1% last Int. longer
400-440 ; 360-400	Last Int. longer	21	19	48	0	88	
	Equally long	57	60	32	72	221	
Last Int. 80 σ longer: 40	First Int. longer	1	0	0	10	11	167/320 = 52.2% last Int. longer
400-480 ; 320-400	Last Int. longer	42	56	69	1	178	
	Equally long	37	24	11	69	141	
Totally	First Int. longer	98	124	2	194	418	115/1600 = 7.2% first Int. longer
	Last Int. longer	72	78	152	1	303	
	Equally long	230	198	246	205	879	

for the order vacant — filled-up; and 50 for the order filled-up — vacant.

The average sensitivity in this experiment-series amounts to 58, which is therefore considerably higher than with the intervals of 3200 σ , which only amounted to 36.8 there. Now if we compute the apparent shortening in the same way as with the preceding experiment-series, we come to highly important results:

Order filled-up — filled-up; equal estimation with 1st interval:

395.7 σ and 2nd interval: 404.3 σ ; i.e. an apparent shortening of the second interval of 2.1 %.

Order vacant — vacant; equal estimation with 1st interval:

393.7 σ ; and 2nd interval: 406.3 σ ; i.e. an apparent shortening of the second interval of 3.1 %.

Order vacant — filled-up; equal estimation with 1st interval:

433.1 σ and 2nd interval: 366.9 σ ; i.e. an apparent shortening of the first interval of 15.3 %.

Order filled-up — vacant; equal estimation with 1st interval:

361.4 σ and 2nd interval: 438.6 σ ; i.e. an apparent shortening of the second interval of 17.6 %.

From these data it is evident that the result in the order vacant — filled-up deviates from the result in the order filled-up — filled-up; it also appears that the result in the order vacant — vacant deviates from the result in the order filled-up — vacant. This makes it clear that the contents of the first interval influence the estimation of the duration of that interval. In the same way we see that the result in the order filled-up — filled-up deviates from the result in the order filled-up — vacant and that the result in the order vacant — filled-up deviates from the result in the order vacant — vacant. From this it becomes clear that the either or not being filled-up, also of the second interval influences the estimation of the duration of that interval.

Although the either or not being filled-up has an influence both on the estimation of the duration of the first as on that of the second interval, this influence need not be equal in the two cases. In order to get an impression of this we set to work, just as in the preceding investigation-series, in the following way. From the results in the order vacant — vacant we can approximately calculate that 400 σ vacant in the first interval must be

estimated as being equally long as 412.8 σ vacant in the second interval; in the same way we can compute from the results in the order vacant — filled-up that 400 σ vacant in the first interval are estimated as being equally long as 338.9 σ filled-up in the second interval. From this it follows that in the second interval 412.8 σ vacant are estimated as being equally long as 338.9 σ filled-up, so that in the second interval the influence of its being vacant or filled-up is such that with these short times a filled-up interval is estimated as being $\frac{412.8}{338.9} = 1.22$ times longer than a vacant interval.

We might execute a similar calculation by comparing the results in the order filled-up — vacant with those in the order filled-up — filled-up. It appears then that 400 filled-up in the first interval are estimated as being equal to 485.4 σ vacant in the second interval or 408.7 σ filled-up in the second interval. The influence of its being vacant or filled-up in the second interval, computed from these data, makes us see that with these short times the filled-up interval is estimated as being $\frac{485.4}{408.7} = 1.19 \times$ longer than the vacant interval.

In a similar way we can compute the influence of its being vacant or filled-up with regard to the first interval. On comparing the results in the order vacant — vacant with those in the order filled-up — vacant, we find that 400 σ vacant in the second interval are estimated as being equal to 387.6 σ vacant in the first interval and to 329.6 filled-up in the first interval, so that with these short times a filled-up interval is estimated as being $\frac{387.6}{329.6} = 1.18 \times$ longer than a vacant interval, if this concerns the interval first presented.

Finally we can still compare the results in the order vacant — filled-up with those in the order filled-up — filled-up. Then we find that 400 σ filled-up in the second interval are apparently of equally long duration as 472.2 σ vacant or 391.5 σ filled-up in the first interval. From this it follows that in the first interval the filled-up interval is estimated as being $\frac{472.2}{391.5} = 1.21 \times$ longer than the vacant interval.

If there is any difference at all between the influence of its

Objectively										
	First Interv. Last Interv.	filled up filled up								
	Mean duration	3200 σ						1600 σ	800 σ	
	Break	6400 σ	3200 σ	1600 σ	800 σ	400 σ	0	1600 σ	1600 σ	800 σ
First Int. 20% longer or Last Int. 20% shorter	First Int. longer Last Int. longer Equally long	0 8 32	0 5 35	0 4 36	0 11 29	0 7 33	1 2 37	1 4 35	25 2 13	26 0 14
First Int. 10% longer or Last Int. 10% shorter	First Int. longer Last Int. longer Equally long	0 13 27	0 11 29	0 6 34	0 17 23	0 15 25	0 5 35	0 5 35	8 2 30	8 2 30
First and last Int. equally long	First Int. longer Last Int. longer Equally long	0 15 25	0 21 19	0 20 20	0 23 17	0 20 20	0 13 27	0 16 24	5 2 33	0 4 36
Last Int. 10% longer or First Int. 10% shorter	First Int. longer Last Int. longer Equally long	0 24 16	0 31 9	0 25 15	0 27 13	0 25 15	0 22 18	0 24 16	0 14 26	1 14 25
Last Int. 20% longer or First Int. 20% shorter	First Int. longer Last Int. longer Equally long	0 32 8	0 29 11	0 29 11	0 39 1	0 30 10	0 30 10	0 38 2	0 27 13	0 37 3
Totally	First Int. longer Last Int. longer Equally long	0 92 108	0 97 103	0 84 116	0 117 83	0 97 103	1 72 127	1 87 112	38 47 115	35 57 108
Sensitiveness for obj. proportions		28.7	40.	39.4	30.	26.9	39.4	45.6	56.2	63.1
Apparent shortening expressed in terms of percentages.....		1st I. 27.3	1st I. 21.6	1st I. 19.2	1st I. 32.6	1st I. 30.6	1st I. 16.5	1st I. 17.2	1st I. 1.6	1st I. 3.4
Number of experiment-series		1	2	3	4	5	6	7	8	9

TABLE X

SUBJECTIVELY

up up		vacant vacant												vacant filled up					
800 σ		400 σ						3200 σ				400 σ			3200 σ		400 σ		3200 σ
800 σ	800 σ	1600 σ	800 σ	400 σ	200 σ	0	3200 σ	1600 σ	400 σ	0	1600 σ	400 σ	0	1600 σ	400 σ	1600 σ	400 σ	1600 σ	400 σ
25	26	27	25	22	20	24	2	0	0	9	39	33	24	1	0	0	2	2	2
2	0	0	0	0	0	0	1	6	4	1	0	0	0	3	3	0	0	0	0
13	14	13	15	18	20	16	37	34	36	30	1	7	16	36	37	40	38	33	33
8	8	22	18	11	18	15	0	0	0	1	18	17	17	0	0	0	0	0	1
2	2	0	0	0	0	2	7	9	9	1	0	0	0	6	10	8	3	4	4
30	30	18	22	29	22	23	33	31	31	38	22	23	23	34	30	32	37	34	34
5	0	7	4	6	9	13	0	0	0	0	5	11	11	1	0	0	0	0	0
2	4	4	0	5	0	0	16	17	13	5	2	1	6	18	21	15	9	11	11
33	36	29	36	29	31	27	24	23	27	35	33	28	23	21	19	25	31	29	29
0	1	2	0	0	2	7	0	0	0	1	0	1	8	0	0	0	0	0	0
14	14	5	4	16	4	1	22	21	27	14	10	9	12	22	28	31	17	28	28
26	25	33	36	24	34	32	18	19	13	25	30	30	20	18	12	9	23	18	18
0	0	0	0	1	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0
27	37	17	19	25	8	3	29	33	32	20	27	29	11	30	32	39	30	29	29
13	3	23	21	14	32	33	11	7	8	20	13	11	25	10	8	1	10	13	13
38	35	58	47	40	49	63	2	0	0	11	62	62	64	2	0	0	2	3	3
47	57	26	23	46	12	6	75	86	85	41	39	39	29	79	94	93	59	74	74
15	108	116	130	114	139	131	123	114	115	148	99	99	107	119	106	107	139	123	123
6.2	63.1	58.7	55.	62.5	42.5	23.1	37.5	31.9	40.0	33.7	76.2	70.	45.6	37.5	40.6	53.1	37.5	41	41
1st I.	1st I.	2d I.	2d I.	1st I.	2d I.	2d I.	1st I.	1st I.	1st I.	1st I.	2d I.	2d I.	2d I.	1st I.	1st I.	1st I.	1st I.	1st I.	1st I.
6	3.4	5.3	4.3	0.9	8.3	21.9	17.7	23.8	19.2	8.5	3.0	3.2	7.4	18.6	20.7	16.1	14.1	15	15
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	26

		filled up vacant					Together	Certainty- percentage
0 σ		3200 σ			400 σ			
400 σ	1600 σ	400 σ	1600 σ	400 σ				
2	2	2	39	34	358	288/1160=24.8%	first Int. longer	
0	5	4	0	0	70			
38	33	34	1	6	732			
0	1	0	31	25	210	68/1160=5.9%	first Int. longer	
3	5	6	0	0	142			
37	34	34	9	15	808			
0	0	0	24	23	119	181/1160=15.6%	last Int. longer	
9	11	23	0	0	300			
31	29	17	16	17	741			
0	0	0	4	4	30	466/1160=40.1%	last Int. longer	
17	25	22	0	0	496			
23	15	18	36	36	634			
0	0	0	6	4	19	713/1160=61.5%	last Int. longer	
30	28	28	0	1	732			
10	12	12	34	35	409			
2	3	2	104	90	736	1004/5800=17.3%	last Int. longer	
59	74	83	0	1	1740			
139	123	115	96	109	3324			
1	37.5	41.9	36.2	54.4	45.6	42.4		
1st I.	1st I.	1st I.	2d I.	2d I.				
1	14.1	15.6	20.1	17.5	17.8			
	25	26	27	28	29			

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being vacant or filled-up with the first and the second interval, it is at any rate very slight. We believe we ought to neglect this small difference so that we can say that with intervals of about 400 σ the filled-up interval is estimated as being $1.2 \times$ longer than the vacant one.

This eighth investigation-series has therefore taught us the following:

1. With short times of about 400 σ the contents of the interval are highly significant in judging the apparent duration. The interval filled up with a continuous perception of light is on an average estimated as being $1.2 \times$ longer than the so-called vacant interval.
2. On comparing two successive short intervals the influence of the contents with regard to the first and to the second interval are almost equal.
3. If the change in one of the intervals of about 400 σ amounts to 20 %, this change is recognized on an average in 58 % of the observations. The sensitivity as to the recognition of objective proportions is therefore considerably greater with these short intervals than with the longer intervals of 3200 σ .

Synopsis.

Though at the end of each of the eight investigation-series the chief results were once more summed up, it does not seem useless to us again to consider these results in a common connection. To this end we have composed table X in addition, which gives a survey of all 29 experiment-series.

Reliability of the data.

Notwithstanding the fact that in every experiment-series 200 observations were made and each of the five groups into which the experiment-series was divided consisted of 40 observations, we see that this number of 40 observations several times was not yet large enough to guarantee a perfect regularity of the results. We could, however, point out in every investigation-series that the correlation between the objective proportions and that which we have computed as certainty-percentage, was nevertheless quite satisfactory. Also in survey-table X a certainty-percentage has been computed. As this certainty-percentage has been obtained as an average from observations

in which the first interval was estimated as being longer and in which the second interval was estimated as being longer, i.e. as an average from experiment-series with entirely different and therefore incomparable results, it has little or no value as a measure of certainty. The value consists in the increase or decrease of the certainty-percentage, in case one of the two intervals became 10 % longer or shorter. In the survey-table these leaps amount to 18.9, 21.5, 24.5 and 21.4, i.e. an average of 21.6. If, therefore, the duration of one of the intervals becomes 10 % longer or shorter, the certainty-percentage changes with 21.6 %. Should the duration of one of the intervals change 20 %, the certainty-percentage would consequently rise or fall with 43.2 %.

This number very beautifully agrees with the average sensitivity computed from the 29 experiment-series amounting to 42.4. This number really does not mean anything else but increase or decrease of the percentage of certain observations, in case one of the intervals becomes 20 % longer or shorter. It is therefore the same as the preceding, only computed in a somewhat different way. The good correlation between the changes in the certainty-percentage and the objective proportions of time as well as the beautiful agreement of the values 43.2 and 42.4, obtained along different ways, have strengthened our confidence in the results obtained.

The sensitivity as to the perception of objective differences in time.

Though the average sensitivity amounts to 42.4, it nevertheless immediately appears from the survey-table that this sensitivity was far from being equal in all experiment-series and that with the intervals of shorter duration it is considerably higher than with the intervals of longer duration. We want, therefore, to compute the average sensitivity for the different long intervals, in which we shall, however, eliminate those experiment-series in which there existed no break ($\text{break} = 0 \sigma$) between the two intervals, as in that case we get to do with very particular conditions. Then we find the following:

with intervals of 3200 σ an average sensitivity of 35.9; with intervals of 1600 σ a sensitivity of 45.6; with intervals of 800 σ a sensitivity of 59.6; and with intervals of 400 σ a sensitivity of 54.5.

From this it becomes apparent, therefore, that the sensitivity not only absolutely, but also relatively increases in the intervals diminishing from 3200 σ to 800 σ . So with these intervals the sensitivity as to the observation of differences in time is not in accordance with the law of *Weber-Fechner*; for in that case the sensitivity computed by us would have to remain equal. With intervals below 800 σ the sensitivity seems to decrease a little again. We are of opinion, though, that this has to be ascribed to the inevitable oscillations in similar investigations, which idea is supported by the fact that the very highest sensitivity was after all met with in the case of intervals of 400 σ (experiment-series 19 and 20) and that the average sensitivity for easily comparable intervals of 400 σ , computed in the eight investigation-series did already amount to 58. We would conclude therefore that the increase of sensitivity with decreasing intervals comes to an end at about 800 σ . Consequently the duration in time of about 800 σ constitutes a critical point, which again and again makes itself felt as something particular in all kinds of investigations with which duration in time has anything to do. Already in the investigations concerning the apparent movement it became evident that the last remnant of the apparent movement disappears in case the interval between the first and second exposition amounts to more than 800 σ . On the ground of this, therefore, we think we are entitled to assume that with the intervals of 800 σ and less we made use of, there must exist a certain link between the limiting stimuli, owing to which the interval is perceived as a whole, is conceived as a shape ("Gestalt") which as such is shown up against a vague background of time.

As long as the interval can be conceived as a whole, as a distinct shape, the perception of differences in time may obey the law of *Weber-Fechner*. These results obtained with small intervals, seem to accentuate the direct sensory character of the estimation of duration and, besides clearness and colour, size and weight etc. to give a relatively simple, singular and independent stamp to the "duration". Under these circumstances there is as yet no question of beginning and end, the duration being indeed experienced as having a character of its own, and a shape of its own, against a momentarily vague background of time, just as the clearness is experienced against a background of vague

contrasts until the moment at which these contrasts crowd to the fore and the place of the clearness in question is fixed between these.

The tension between the indeterminate vague background of sleeping internal life and the figure in the shape of a circumscribed interruption of continuity rousing one from this condition, gives the impression of and a measure for the duration. The greater this tension, the more fierce and surprising the impression roused, the slighter the duration will seem to one.

If one has to judge longer intervals the duration threatens to fade away into the indeterminate background; the duration then clearly shows a beginning and an end and is weighed with regard to that which takes place in the background; this background besides past and future contains a present which is perceived as the duration between the two. The limiting stimuli now no longer constitute a unity with the contents; they form no shape together; the stimuli, the distance in time between which we must judge of, now lie more or less as separate perceptions on a neutral path.

It is possible that in this case we are going to judge time from all kinds of experiences, all kinds of tensions and all kinds of repressions being enacted in our mind between the limiting perceptions. We might draw the comparison with the emptiness of a road we cannot overlook, but which we can judge of with respect to the streets and houses we passed. Be this as it may, a great many more investigations will be necessary in order to obtain some certainty regarding this problem.

Influence of the break between the two intervals.

In our investigations the influence of the objective duration of the break has appeared to be only slight. It was only with the intervals of short duration filled up with a continuous perception of light, that the duration of the break proved to have some importance. We accounted for this by stating that the break, too, is an interval, limited by two stimuli which may join to form a unity. This link will less soon come about, because our attention is not fixed on the duration of the break; nevertheless this link will not fail to take place if the circumstances for it are favourable. These circumstances are favourable if the break is short and so-called vacant and if the

intervals are long and filled up with conspicuous contents. In proportion as the break contracts more markedly and more steeply into a unity, the second interval will become vaguer in its beginning. All this makes it comprehensible that with a short vacant break and short filled-up intervals the last interval will be estimated as being longer than in case of a longer break; it also renders it intelligible that this phenomenon will not or scarcely manifest itself with a short filled-up break and vacant intervals. We should certainly, however, also have expected some influence with a short, vacant break and long filled-up intervals, especially if we should compare this with the results in case of a short filled-up break and long, vacant intervals. On reviewing our results this influence indeed appears to be very clearly present: with filled-up intervals of 3200 σ and breaks of 3200 σ and 1600 σ the apparent shortening of the first interval averages 20.4 %; with vacant intervals of 3200 σ and breaks of 3200 σ and 1600 σ the apparent shortening of the first interval averages 20.7 %; i.e. almost the same as with the filled-up intervals. With the filled-up intervals of 3200 σ and a break of 400 σ on the contrary, the apparent shortening of the first interval is 30.6 % and with the vacant intervals of 3200 σ and a break of 400 σ it only amounts to 19.2 %. So there is in fact a very great difference in the apparent shortening of the first interval, in proportion as the intervals are filled-up or vacant and the breaks vacant or filled-up. We believe this must be accounted for by the fact that owing to the apparent shortening of the short vacant break the second interval becomes apparently longer. We also meet with the same phenomenon in case of a short, vacant break of 800 σ ; upwards of this it is no longer observed, so that here again there is a limit formed by the duration of 800 σ . So if one wants to eliminate the influence of the break it will have to be made longer than 800 σ ; if not, one will have to take the influence of the break into account.

We have repeatedly pointed out the remarkable phenomena which may occur with very short breaks, if the objects, which by their presence or absence must mark the interval to be judged, lie too close to each other. Then an apparent movement of the objects manifests itself, the attending localization-phenomena causing the first interval to be estimated as being longer at the cost of the second interval. This apparent movement more-

over demonstrates the link between the stimuli limiting the break, so that sometimes it will apparently disappear altogether, if the break is of very short duration.

Consequently, if the objects are adjoining or lie close together, the break contracting still further, may get lost and transform itself into an attribute of another phenomenon, that of the apparent movement. Movement in time shifts into movement in space. The background against which movement in time took place, seems to become different. It is no longer a background formed by past, future and present of internal experiences, against which the lack of a light-impression rouses the figure of a break, but now it is a background of spatial factors, against which the break, reduced to 0, creates the figure of movement having the duration as an attribute.

Significance of the so-called being vacant and filled-up of the intervals.

Already in earlier investigations we found that a so-called vacant interval is estimated as being shorter than an interval filled up with a continuous perception of light which more or less drew the attention. At the time we chiefly made use of intervals of 1800σ and found in that case an apparent shortening of the vacant interval with regard to the filled-up interval, amounting to about 12 %. We were, therefore, a little surprised that in the above investigations we found back so little of this apparent shortening with intervals of 3200σ . There are, however, with these so-called vacant and filled-up intervals a few highly uncertain factors. In the first place we always speak on purpose of "so-called" vacant, because a perfectly vacant interval is non-existent and in our experiments the so-called vacant interval was even filled up with light-stimuli. The only semblance of right we have in speaking of a vacant interval is that the interval was marked by the absence of one of the squares projected on the wall. In the second place the contents of the interval are not only of importance because of the strength of the physical stimuli, but also because of other factors also fixing the attention; we might say that the weight of the contents is of importance. It is obvious that this weight is not always the same. Owing to this there may arise oscillations in the apparent duration of the intervals, so that a possible difference in estima-

tion of duration between vacant and filled-up intervals, if only slight, may hide behind these oscillations.

In case the difference between the estimation of duration of vacant and filled-up intervals is founded on the fact that the weightier contents more rapidly repress the preceding physiological processes, it is very well possible that this difference is a constant amount, if the difference in weight of the contents is constant and independent of the length of the interval. Then the difference between vacant and filled-up would clearly come to light with intervals of short duration, therefore, and might remain hidden with intervals of longer duration.

The difference in estimation between vacant and filled-up intervals is very clearly shown in the experiment-series 24, 25, 28 and 29 with intervals of about 400 σ . A second question is whether this difference in estimation between vacant and filled-up intervals, on comparing two successive intervals has the same importance for both intervals. As the order influences the judgment and as consequently the judgment of the first and of the second interval differ somewhat, their being vacant or filled-up might also have a different meaning for both intervals. The results of the eighth investigation-series have taught us, though, that the significance of their being vacant and filled-up is the same for both intervals. Just as with the long intervals of 3200 σ the influence of their being vacant or filled-up shrinks into insignificance beside the influence of order, thus with the short intervals of 400 σ the influence of order shrinks into insignificance beside the influence of their being vacant or filled-up.

On comparing two vacant intervals and two filled-up intervals with each other, we shall find the same results. The difference we met with were in our opinion to be ascribed to the influence of the break.

Significance of the objective duration of the intervals.

On comparing two successive intervals the influence of the objective duration appeared to be very great. If we make the break sufficiently long, so that it can have no influence on the second interval, it appeared that with intervals of longer than from 700—800 σ the second interval was overestimated and that with intervals of shorter than from 700—800 σ the second interval was underestimated.

The over-estimation of the second interval strongly increases in the intervals' lengthening from 800—1600 σ ; upwards of this the increase of over-estimation gradually diminishes.

The under-estimation of the second interval increases in the intervals' becoming shorter.

With the longer intervals one has to take into account all that which is enacted against the background of internal events and which will offer a changing, uncertain standard for the indirect judgment of the duration.

We should be pleased to give an explanation of these phenomena. We are of opinion, however, that the results obtained are still insufficient for building up a well-founded hypothesis on them, so that we shall refrain from this for the present.

DAS PHÄNOMENOLOGISCHE PROBLEM VON LICHT UND SCHATTEN

von

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In Eckermanns „Gespräche mit Goethe“ gibt es eine Stelle, an der über eine Landschaft von Rubens die Rede ist. Eckermann wundert sich darüber, dass die Menschen im Vordergrund des Bildes im Schatten grosser Bäume stehen und ihren eigenen Schatten in entgegengesetzter Richtung werfen, dass also das Licht von entgegengesetzten Seiten zu kommen scheint. Goethe bemerkt dazu, dass trotz dieses Widerspruchs das Ganze dennoch durchaus anschaulich und harmonisch wirkt ¹⁾).

Hier stossen wir auf eine Grunderscheinung der Beleuchtungswahrnehmung: phänomenologisch mögliche und vorkommende Erscheinungsweisen von Licht und Schatten im Verhältnis zu den physikalischen, objektiven Tatbeständen.

Betreffend des Paradoxes von Rubens verweise ich schon jetzt auf die später von mir erwähnten Beispiele, wo die Einheit der Beleuchtung phänomenal aufgespaltet werden kann.

Es ist ziemlich leicht, eine ausreichende und eindeutige *physikalische Definition* für einerseits die Beschattung und andererseits die Belichtung zu geben. Um zuerst einmal über Beschattungsphänomene und verschiedene Arten des Schattens zu sprechen, sagt man zum Beispiel, dass es sich immer dort um einen Schatten handelt, wo die Beleuchtung nicht im selben Masse reflektiert wird wie an den übrigen vorhandenen Oberflächen. Schatten bedeutet somit ein Bereich mit herabgesetzter Beleuchtungsintensität. Dazu käme der Spezialfall des Voll- oder Kernschattens, der überall vorkommt, wo kein *direktes* Licht von der jeweiligen Lichtquelle auftritt. In entsprechender Weise kann man die Belichtung als Beleuchtungszuwachs eines Teilbereichs im Verhältnis zum allgemein vorhandenen reflektierten

¹⁾ Gespräch am 18. April 1827. Herausgabe von Adolf Bartels, Bd. II. Leipzig 1902, S. 305, ff.

Licht bezeichnen. Damit wäre die ganze Sache als eine vom *physikalischen Standpunkt* aus höchst triviale Angelegenheit erledigt.

Jedermann weiss jedoch, dass das Ereignis, welches wir physikalisch in so eindeutiger Weise als „Schatten“ beschreiben, in unmittelbarer Anschauung unzählbar mannigfache Erscheinungsformen in sich birgt. Einmal wird die Stelle, an der eine verminderte Beleuchtungsintensität vorhanden ist, als Schatten erlebt, ein anderes Mal aber unter nur wenig veränderten Umständen nicht. In der Welt, wie sie für uns aussieht, besteht ein grosser Unterschied zwischen der diffusen, raumerfüllenden Dunkelheit einer Zimmerecke, dem scharfen, dinghaften Schatten eines Baumes auf besonnte Schnee oder den zart verlaufenden Schattengrenzen eines Kahnes im kristallklaren Seespiegel, die kegelartig bis zum sandigen Boden des Sees hinabreichen, um dort wie ein dünnes Häutchen liegen zu bleiben. Die Erscheinungswelt und die eventuelle Gesetzmässigkeit dieser Licht- und Schatteneindrücke ist besonders bedeutsam für den Maler, dessen Erfolg darauf beruhen kann, dass diese Effekte richtig getroffen werden. So ist es auch kein Zufall, dass noch die Wahrnehmungspsychologie von heute die grundlegende und bahnbrechende deskriptive Beschreibung dieser Erscheinungen dem berühmten Maler und Naturforscher *Leonardo da Vinci* verdankt. Von ihm ist eine umfassende und tiefgehende Untersuchung über Licht und Schatten erhalten. Der Psychologe sucht den Malern ein mehr systematisch bearbeitetes Tatsachenmaterial zu verschaffen und grössere phänomenologische Zusammenhänge aufzudecken. Die Psychologie behandelt die Licht- und Schattenverhältnisse, wie sie uns erscheinen, nicht aber deren physikalische Voraussetzungen. Gerade diese Erscheinungsweisen des Schattens z.B. enthalten viele Probleme. Was physikalisch Schatten ist, braucht es nicht phänomenal zu sein, und andererseits kann ein phänomenaler Schatten vorhanden sein, ohne dass er in physikalischer Beziehung feststellbar ist.

Wir werden somit versuchen, die unmittelbar vorkommenden Erscheinungsweisen der Beschattung — bezw. der Belichtung — festzustellen und zu begründen, worauf es beruht, dass in verschiedenen Fällen gerade die betreffende Erscheinungsform sich gegenüber allen anderen durchsetzt.

Von Leonardo da Vinci reicht eine Kette feiner Beobachtungen

und immer genaueren terminologischen Feststellungen über eine Anzahl in Deutschland arbeitender Forscher wie *Hering* ²⁾, *Karl Bühler* ³⁾, *Katz* ⁴⁾ und den Ungarn *Kardos* mit seinem Buch „*Ding und Schatten*“ bis zum führenden deutschen Wahrnehmungspsychologen von heute: *Wolfgang Metzger* und seiner Schule, der wir einige schöne Einzeluntersuchungen über diese Phänomene verdanken. Ich werde zuerst das Wesentliche der Ergebnisse dieser älteren Forschung über mein Thema zusammenfassen und zum Schluss einige Beobachtungen und Gesichtspunkte anführen, die vielleicht eine einheitliche systematische Lösung des Problemkreises bedeuten.

Schon seit den Zeiten Leonardo da Vincis ist die Einteilung der erlebten Schattenphänomene in anhängende Schatten, Luftschatten und Schlagschatten üblich. Wir sagen mit Metzgers Schülern statt anhängender Schatten lieber *Körperschatten* und unterscheiden die entsprechenden Belichtungsphänomene in Körperlicht, Luftlicht und Schlaglicht.

1. *Körperschatten* entsteht, wenn ein Gegenstand, z.B. eine undurchsichtige Kugel einseitig beleuchtet wird. Die Rückseite bleibt unbeleuchtet, d.h. also schattig. Dieser Schatten haftet dem schattenwerfenden Körper an. Das beste Beispiel ist vielleicht der Körperschatten des Mondes, der verursacht, dass wir bisweilen nur einen „Halbmond“ sehen, bisweilen sogar nur einen schmalen Streifen des Mondes.

2. *Luftschatten*: Ein in einseitiger Beleuchtung befindlicher Gegenstand schirmt die Beleuchtung in dem hinter ihm liegenden Raum ab. Der Gegenstand fungiert somit als Schattenwerfer. „Dahinter geht der Schattenkegel durch die Luft, bis er durch eine neue Körperoberfläche aufgefangen wird.“ ⁵⁾

Als Beispiele hierfür nennen frühere Forscher den Raum einer beschatteten Zimmerecke oder den dunklen Raum, der entsteht, wenn ein Schlagschatten auf hochragenden Gräsern liegt. Dann sieht man die Halme in den Luftschatten hinein-

²⁾ Hering, E., Grundzüge der Lehre vom Lichtsinn (in Graefe-Saemisch: Handbuch der gesamten Augenheilkunde); Leipzig 1905—1911.

³⁾ Bühler, Karl, Handbuch der Psychologie. I Teil: Die Struktur der Wahrnehmungen. 1 Heft: Die Erscheinungsweisen der Farben, Jena 1922.

⁴⁾ Katz, David, The World of Colour, London 1935.

⁵⁾ Bühler, a.a.O., S. 76.

ragen. In einem geeigneten Zwischenmedium, z.B. im klaren Wasser, sieht man den Kegel als genaues Gegenstück zum Lichtkegel eines Scheinwerfers in der Nacht. Wir wollen auch in entsprechender Weise im letzteren Fall von Luftlicht sprechen. Zwar ist die herkömmliche Bedeutung für Luftlicht in der Literatur eine etwas andere.

3. *Schlagschatten*, der aufliegende Schatten, ist wohl der auffallendste und am meisten dinghafte aller Schattenarten. Er wird uns auch im folgenden phänomenologisch am stärksten interessieren. In vielen Fällen, wenn sein Rand scharf und sprunghaft ist, hat er auch deutlich die Form des schattenwerfenden Gegenstandes. Diese Eigenschaften haben es offenbar mit sich gebracht, dass primitive Völker den Schlagschatten so weitgehend personifiziert haben, dass er als Träger der Seele gilt. Das Trampeln auf dem Schatten seines Nächsten ist bekanntlich die grösste Taktlosigkeit die man sich unter primitiven Menschen denken kann.

Die entsprechenden Belichtungserlebnisse müssen auch kurz beschrieben werden.

Ueber 1 *Luftlicht* haben wir bereits gesprochen.

2 *Körperschatten* ist, ebenso wie Körperschatten, vorhanden, wenn ein Körper einseitig beleuchtet ist. Die beleuchtete Seite des Körpers reflektiert mehr Licht als die Umgebung. Das beste Beispiel hierfür ist wieder der Mond.

3. *Schlaglicht* wird von Lotte Lauenstein, der Schülerin Metzgers wie folgt definiert: „Es entsteht dort, wo zwei räumliche Innenwinkel aneinderstossen und die eine hellbeleuchtete Fläche Licht auf die andere Fläche reflektiert und somit ein gewisses Gebiet derselben von der Beleuchtung der übrigen Fläche abgehoben wird. Es handelt sich hierbei um zweimal reflektiertes Licht, das anschaulich keine scharfen Konturen haben kann. Es ist *phänomenal* nur in verhältnismässig wenig Fällen Schlaglicht.“⁶⁾ Phänomenaler Gegenpol des Schlagschattens ist auch eigentlich der *aufliegende Lichtfleck*, den ich auch in dieser Bedeutung theoretisch behandeln werde.

Wenn ich jetzt näher auf einige eigenartige Erscheinungsformen und deren plötzliche Umschläge eingehe, spreche ich zunächst ausschliesslich über Beschattung. Die Schattenphäno-

⁶⁾ Lauenstein, Lotte, Psychologische Forschung 22, 1938, S. 290.

mene sind leichter experimentell hervorzurufen und auch häufiger unmittelbar beobachtet worden. Was über Beschattung und Schattenflecken gesagt wird, gilt mutatis mutandis für Belichtung und Lichtflecken.

Bei dem Problem der Wahrnehmung, das ich hier aufzurollen versuche, handelt es sich eigentlich um Schlagschatten und Lichtflecke. Zuerst möchte ich aber einige Bemerkungen über Körperschatten und Körperlicht vorausschicken. Luftschatten haben in diesem Zusammenhang kein Interesse.

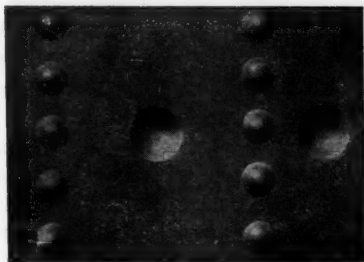


Fig. 1.

Bei Flächen, die reliefartige Vorsprünge und Einbuchtungen aufweisen, kommt es vor, dass bei einseitiger Beleuchtung der Körperschatten an den Einbuchtungen auf dem entgegengesetzten Rand wie an den Vorsprüngen liegt. (Fig. 1.) Entsprechend verhält es sich mit dem Körperlicht. Phänomenal folgt hieraus, dass, wenn man die ganze Fläche herumdreht, die ehemaligen Vorsprünge jetzt als Vertiefungen erscheinen und umgekehrt. Der Beschauer hat nämlich die Tendenz, die Beleuchtungsrichtung als unverändert wahrzunehmen. In Fällen, wo die Vp nicht die wirkliche Beleuchtungsrichtung kennt, würde sie entweder Vorsprünge oder Vertiefungen sehen können. Die phänomenale Raumform entwickelt sich jedoch im allgemeinen nicht so, dass die Beleuchtung infolge der Verteilung von Körperlicht und Schatten als in viele Teilbeleuchtungen aufgespaltert vorausgesetzt werden müsste. Immer resultiert ein Gesamtheitseindruck, in dem die Verteilung von Licht und Schatten mit einer Einheitlichkeit der Beleuchtung übereinstimmt. *Turhan*, der Schüler *Metzgers*, hat dies sehr schön in seinen Versuchen

gezeigt ⁷⁾. Er spricht von einer *Einheit der Beleuchtung*. Auch wenn physikalisch eine Aufspaltung der Beleuchtung vorliegt, wird lieber die gekrümmte Fläche so erlebt, dass sie *phänomenal* einer einheitlichen Beleuchtung entspricht. Diese Tendenz wird auf eine andere zurückgeführt, die *Tendenz zur Homogenität der Färbung*. Körperlicht und Körperschatten wird nicht als phänomenale Intensitätsverschiedenheit der Oberflächenfarbe erlebt, sondern die Oberfläche erscheint weitergehend als homogen gefärbt und Licht und Schatten *als etwas Daraufliegendes*.

Man hat darüber diskutiert, ob das Sehen gemäss einer Beleuchtungseinheit eine gewisse phänomenale Richtung mehr voraussetzt als die übrigen. Metzger hat behauptet, dass eine Beleuchtung von oben oder von links besonders gern vorausgesetzt wird ⁸⁾. Meine Experimente in Helsinki haben gezeigt, dass die phänomenale Beleuchtung von oben bevorzugt ist, nicht aber eine linksseitige vor einer rechtsseitigen. Ausserdem habe ich eine Einheit entdeckt, die mit der Beleuchtungseinheit konkurriert. Ich nannte sie Einheit der Raumformen ⁹⁾. Das Sehen von Vorsprüngen setzt sich besonders stark durch, so dass alle Gebilde, wenn es nur möglich ist, als Vorsprünge aufgefasst werden. Einige Vpn reagieren so *auf Kosten der Beleuchtungseinheit*. Lauter Vorsprünge werden gesehen, aber von Vorsprung zu Vorsprung in verschieden gerichteter Beleuchtung. Dies deutet darauf hin, dass die Wahrnehmung der Beleuchtungsrichtung eine Gliederung höherer Gliederungsstufe bedeutet, die sich nicht überall durchsetzt und überhaupt erst dann, wenn die übrigen Gestaltungen, z.B. die Einheit der Raumformen, keine genügende Einheitlichkeit bewirken.

„Der anhaftende Schatten legt sich, wie schon in seiner Benennung zum Ausdruck kommt, der Farbe des Dinges so fest an, dass es nicht recht gelingen will, ihn von der eigentlichen Farbe des Dinges loszulösen.“ ¹⁰⁾ Lauenstein bemerkt, wie sehr die Phänomenologie des Lichtes und Schattens sich von ihrer physikalischen Beschreibung unterscheidet. Es gibt nämlich einen

⁷⁾ Turhan, M., Psychologische Forschung 21, 1935, S. 45.

⁸⁾ Metzger, Wolfgang, Gesetze des Sehens, S. 128.

⁹⁾ Vgl. v. Fieandt, Ueber Sehen von Tiefengebilden bei wechselnder Beleuchtungsrichtung, Helsinki 1938.

¹⁰⁾ Katz, Der Aufbau der Farbwelt, Leipzig 1930, S. 59.

Bereich der mittleren Helligkeit zwischen Licht und Schatten, der phänomenal keinen der beiden Gebiete zugeordnet wird. Als Körperlicht und Körperschatten erscheinen besonders solche Bereiche der Körperoberfläche, die sich deutlich von der Helligkeit ihrer Umgebung abheben. Die Vpn unterscheiden z.B. „links ist Licht und rechts ist Schatten“. Das Dazwischen bildet phänomenal das Nullniveau, von dem aus „Erhellung“ und „Verdunklung“ bestimmt werden. Physikalisch betrachtet gibt es natürlich nichts anderes als ausschliesslich Licht und Schatten (nämlich dort, wo das Licht fehlt). — In der Phänomenologie sind die Begriffe Körperlicht und Körperschatten immer relativ zu fassen. *Der jeweils hellste sichtbare Bereich eines Körpers wird phänomenal zum Körperlicht*¹¹⁾.

Dazu ist noch zu-sagen, dass die Erscheinungen des Körper- und Schlagschattens nicht immer mit den ebenso genannten physikalischen Tatbeständen zusammenfallen. Z.B. können in einfachen Helligkeitsfällen die dunkelsten Stellen wie Schatten erscheinen. Der objektive Schlagschatten kann bisweilen zum phänomenalen Körperschatten werden und umgekehrt.

Lauenstein behauptet, dass die Bereiche: Körperschatten, Körperlicht, Schlagschatten, Schlaglicht, wenn sie phänomenal ihre Beziehung zur Beleuchtung verlieren, der Oberflächenfarbe zugeschrieben werden. Demgegenüber möchte ich betonen, dass sie ursprünglich in der Wahrnehmung keine Beziehung zur Beleuchtung haben. Nichtsdestoweniger wird die Farbe der Oberfläche, soweit es überhaupt möglich ist, unverändert gesehen. Erst wenn diese Wahrnehmungsweise so mehrdeutig und kompliziert wird, dass die Berücksichtigung der Beleuchtung eine wesentliche Vereinfachung bedeutet, setzt sie sich als eine höhere Gliederung durch.

Nun zur phänomenologischen Beschreibung des Schlagschattens. Bühler schreibt: „Wie eine Dunkelhaut aus Gelatine oder wie ein Schwarzflor mit unsichtbar dichtem Netzwerk liegt auf der besonnten Strasse der Schlagschatten eines Baumstammes, eines Menschen.“¹²⁾ Das Charakteristische ist eben diese „Florartigkeit“, dieser „Häutchen“-Eindruck. Physikalisch betrachtet liegt ja nur eine Herabsetzung des reflektierten Lichts an der beschatteten Stelle vor. Merkwürdig ist es aber, dass nicht der

¹¹⁾ Lauenstein, a.a.O., S. 289.

¹²⁾ Bühler, a.a.O., S. 76.

Schlagschatten unmittelbar als eine solche Reflexionsveränderung der Oberflächenfarbe erlebt wird, sondern als ein selbständiges phänomenales Ding, das sich zwischen Beschauer und Hintergrund legt. Dieser setzt sich ununterbrochen und ebenso hell wie früher hinter dem Schatten fort. Von grösster Bedeutung ist hier eben diese Gliederung in „vor“ und „hinter“, wie wir später sehen werden. Nicht zu Unrecht machen frühere Forscher darauf aufmerksam, dass dieser Eindruck des „Hintereinander von Schatten und Oberfläche“ beträchtlich abnimmt, wenn man den Schlagschatten tiefer macht. Wird der Schatten hinreichend dunkel, kann man nicht mehr davon reden, dass die „eigentliche“ Körperoberfläche hinter dem Schatten auch nur annähernd gewahrt bliebe. Funktional gesprochen: Wird die Herabsetzung der Beleuchtung allzu gross, dann gestattet sie neben dem Schatteneindruck nicht die Wahrnehmung des Oberflächencharakters, der Körnung oder der sogenannten Mikrostruktur des Hintergrundes. Dies wäre jedoch sehr wichtig für das Erlebnis der Durchsichtigkeit des Gelatinehäutchens. Darum hat der Maler hier ein Mittel, um die Durchsichtigkeit des zarten Schattens hervorzuheben: er lässt die Struktur der Oberflächen, die Maserungen des Holzes, das Stoffmuster der Gegenstände unter den Häutchen weitergehen¹³⁾. In moderner ganzheitspsychologischer Ausdrucksweise würden wir sagen: je mehr gliedert die beschattete Fläche sich erweist, desto grösser ist die Durchsichtigkeit des Schattens und desto grösser die Invarianz der betreffenden Oberflächenfarbe.

Leonardo da Vinci meint, dass kein Schlagschatten auf glänzenden und durchsichtigen Körpern erscheint. Eine Brücke wirft ihren Schatten nur auf einen Fluss mit trüben Wasser. An sonnigen Sommertagen habe ich jedoch sehr schöne Schlagschatten auf dem kristallklaren Spiegel des Saima-Sees beobachtet, einem der grossen finnischen Binnengewässer. Dabei war das Wasser so klar, dass ich den räumlichen Schattenkegel bis zum Boden des Sees verfolgen konnte. Im klaren Fluss liegt der Schatten der Brücke wie ein Häutchen am Boden des Flussbettes.

Den anschaulichen Schlagschatten als Eigenphänomen hat schon Hering experimentell untersucht. Berühmt ist sein Fleck-Schatten-Versuch, wo der merkwürdige Umschlag des unmittel-

¹³⁾ Bühler, a.a.O., S. 80—81.

baren Eindrucks stattfindet, sobald er seinen Schlagschatten *umrahmt*¹⁴⁾. Das Durchsichtige und das freie Vor- und Übersweben beim Schatten verschwindet, und er wird als ein Bereich von dunklerer Tönung in die Ebene des Hintergrundes eingepresst. (Fig. 2.)

Alle diese Veränderungen sind ganz phänomenal, und merkwürdig ist, dass auch nach der Umrahmung nicht die objektiv vorhandene Herabsetzung der Beleuchtung im Schattenbereich eigentlich wahrgenommen wird, sondern eine *verdunkelte Oberflächenfarbe*. Hering neigt in seiner Erklärung selbst zu der Auffassung, dass der objektiv vorhandene breite und verlaufende Halbschattenrand eine Hauptursache des phänomenalen Schatteneindrucks ist. — Daraus ist später eine ganze Theorie dieses Problemkreises erwachsen, die man als

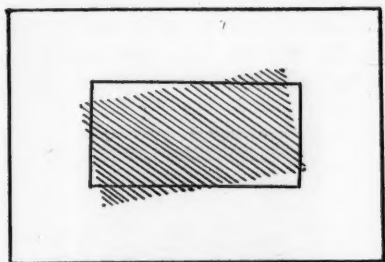


Fig. 2.

einseitig empiristisch-atomistisch bezeichnen kann. Das unklare und nicht umrissene Grenzgebiet, der verlaufende Rand des Schattens, ist nach dieser Ansicht als Hauptcharakteristikum des Schlagschattens anzusehen. In den Randerscheinungen glaubte man eine Art „stellvertretender Anzeichen“ für Beschattung zu sehen. Dieser Auffassung stehen die von den Forschern *Brunswik* und *Tolman* vertretenen Gesichtspunkte nahe¹⁵⁾. Demgegenüber behauptet schon *Bühler*, dass die Veränderung dadurch nicht erschöpfend geklärt ist. Er hat als erster die eigentümliche Gliederung in *zwei Bereiche* nachgewiesen, denen wir überall begegnen, wo der Schlagschatten auf eine Fläche

¹⁴⁾ Hering, a.a.O., S. 8.

¹⁵⁾ Tolman, E. C. and Brunswik, Egon, The organism and the causal texture of the environment. Psychological Review, 42, 1935.

fällt. Diese Gliederung nennt er Tiefensonderung. Ich zitiere: „Das Schattenhäutchen mit durchgesehener Körperoberfläche ist ein praktisch und theoretisch besonders wichtiger Fall der Tiefensonderung“¹⁶⁾. Katz drückt die Sache so aus, dass die Umrahmung eine stufenweise Reduktion bedeutet, also den freien Überblick über die Beleuchtungsverhältnisse verhindert. Je grösser der frei gegliederte Teil des Gesichtsfeldes ist, desto unmittelbarer und durchsichtiger ist der Schatten¹⁷⁾. Schon Kardos weist auf diese von mir später angenommene Erklärung hin.

Ausserdem hat Lauenstein neuerdings mit sorgfältigen Versuchen gezeigt, dass der Halbschattenrand weder eine notwendige noch ausreichende Bedingung des phänomenalen Schlag-schattens ist. Sie zeigte ihren Vpn in unwissenschaftlichen Verfahren ein weiss gestrichenes Brett vor einem gleichfarbigen Hintergrund. Das Brett wurde dann schräg von der rechten Seite beleuchtet, die Vp sah aber die Lichtquelle nicht. Der Beleuchtungswinkel wechselte von Versuch zu Versuch.



Fig. 3.

Wenn ein geradkantiges Brett verwendet wird, wirft es auf

¹⁶⁾ Bühler, a.a.O., S. 77.

¹⁷⁾ Katz, Der Aufbau der Farbweit, S. 206 f.

das 1 cm hinter ihm befindliche Grundbrett einen geraden Schattenstreifen, der dicht bei der Kante liegt und parallel mit ihr läuft. Obwohl der Rand des Schattens sehr verlaufend ist, haben die meisten Vpn keinen Schatteneindruck. Von 10 Vpn sehen 8 unmittelbar einen schwarzen Streifen auf homogen weissem Hintergrund. (Fig. 3.) Es entstand also der Eindruck einer Ebene mit sogenannter Figur-Grund-Gliederung. Wurde aber das Brett zackig gemacht, so entstand bei allen Vpn ein Tiefeneindruck. Das Brett wurde als eine nähere Ebene als das Grundbrett empfunden. Trotzdem wurde aber der Schatten erst bei sehr seitlicher Beleuchtung als solcher erlebt. Ofters erschien der Schlagschatten als ein Flächengebilde, das senkrecht auf der weissen Grundfläche stand. Das zackige Brett erschien wie ein Vorsprung, dessen Seitenkante sich aus dem Schatten ergab.

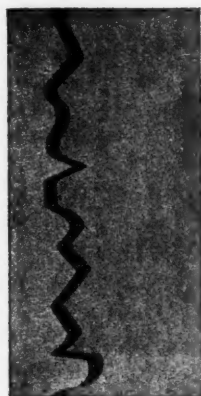


Fig. 4.

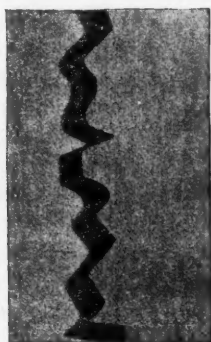


Fig. 5.



Fig. 6.

Eine räumliche Wirkung entstand, aber kein Schatteneindruck¹⁸⁾. — Die Versuche zeigen, dass bei der geraden Kante, wo eine denkbar einfache Gestalt, nämlich ein schwarzer Streifen auf weissem Grund entsteht, kein Schatten- oder Tiefeneindruck erfolgt. Dagegen ist der Schattenstreifen bei der zackigen Kante als Flächengefigur allzu kompliziert, er erscheint nicht eben so breit, und diese labile Auffassung wird darum

¹⁸⁾ Lauenstein, a.a.O., S. 291 ff.

ersetzt durch den „besseren“ Eindruck einer gleich hohen Kante. Auch hier ist die bevorzugte Fassung die einfachere und klarere.

Phänomenaler Gegenpol des Schattenflecks ist, wie gesagt, der Lichtfleck. Es ist schon bei früherer Gelegenheit oft betont worden, dass starke Lichter, z.B. Sonnenflecke, nicht wie durchsichtige Häutchen aussehen. Nichtsdestoweniger erscheinen auch die Sonnenflecke z.B. auf dem Fussboden eines Zimmers als etwas Aufliegendes. Es entsteht die Gliederung vom Grund, der hinter dem Fleck unverändert weiterläuft, und von einem „vor“ oder „auf“ dem Grund liegenden Fleck. Was als Hintergrund erlebt wird und was als Belichtetes oder Beschattetes erscheint, hängt im grossen ganzen davon ab, was im Einzelfall mehr Raum in Anspruch nimmt. Hierauf komme ich noch zurück.

Lauenstein hat ihre „Brettversuche“ auch mit Schlaglichtern gemacht. Jetzt fielen die Lichtstrahlen nahezu senkrecht auf die Kante, und ein kräftiges Schlaglicht entstand. Erst wenn man die Breite des verlaufenden Bandes variierte, entstanden eindeutige Tiefeneindrücke, aber nur bei der gezackten Kante. Die gerade Kante zeigte wieder infolge der einheitlichen Intensität des Schlaglichtes auf ihr und der unkomplizierten Helligkeitsverteilung so gut wie keine Tiefenwirkung. Bei der gezackten Kante kamen invertierte Fassungen vor; die Zacken werden auch als *Eiszapfen* beschrieben. Das hellbeleuchtete Grundbrett wird näher erlebt, und die nun besonders hellen Spitzen an der Kante sehen durchsichtig aus ¹⁹⁾.

So weit die Tatsachen. Jetzt wollen wir eine einheitliche systematische Erklärung versuchen. Ich gehe von der allgemeinen Feststellung aus, dass überall, wo wir im natürlichen Leben aufliegende Schatten oder Lichtflecke erleben, gleichzeitig eine „vor — hinter“ Gliederung vorhanden ist. Es handelt sich hierbei weniger um eine Tiefengliederung, wie es einige Forscher nannten, sondern wir können das Phänomen mit der aus der Gestaltpsychologie bekannten „Figur-Grund-Gliederung“ vergleichen. Wenn es bei Flächenfiguren hauptsächlich auf die Konturen ankommt, wirkt diese Beleuchtungsgliederung, die wir „Fleck- und Grund“-Gliederung nennen wollen, durchaus räumlich. Eine wesentliche Eigenschaft dieser Flecke ist, dass sie *durchscheinend* sind. Die Durchsichtigkeit wird wieder im

¹⁹⁾ Lauenstein, a.a.O., S. 297 ff.

allgemeinen durch die Faktoren bedingt, die *Fuchs* ²⁰⁾ für das Hintereinander zweier Farbflächen analysiert hat und auf die ich nicht näher eingehe. Je stärker der Lichtfleck, je tiefer der Schatten gemacht wird, desto undurchsichtiger wird der Fleck, bis wir bloss neue Mischungen der Oberflächenfarbe wahrnehmen können. Die natürliche Gliederung der Oberfläche kommt dann nicht mehr zum Vorschein. Andererseits: je ausgeprägter die wahrgenommene Gliederung hinter dem Fleck ist, desto durchsichtiger wirkt auch der Fleck.

Es muss aber noch ein weiterer Faktor hervorgehoben werden, auf den Bühler zufällig gestossen ist. In seinen Ratschlägen an die Maler sagt er u.a., dass kleine und schmale Schlagschatten eine viel stärkere deckende Wirkung haben als grosse ²¹⁾. Das ist eine bedeutsame Entdeckung. Man kann im Hering'schen Versuch z.B. die Wirkung der Umrahmung wieder aufheben, indem man mit einem umfassenden Schirm den ganzen Hintergrund beschattet. Die gleiche Herabsetzung der Beleuchtungsintensität, die an begrenzter Stelle der Oberfläche als gewöhnlicher Schlagschatten wirkt, wird, wenn der beschirmte Teil des Wahrnehmungsfeldes grösser und grösser wird, schliesslich zur „herrschenden, normalen Beleuchtung“. So kann man die Durchsichtigkeit im Hering'schen Versuch wieder hervorrufen, wenn man sich dem umrahmten Hintergrund nähert. Im gleichen Masse vermehrt sich die Durchsichtigkeit des Schattens, bis schliesslich bei voller Abschirmung keine Fleck-Grundgliederung mehr besteht. Diese Gliederung ist also um so stärker, je kleiner der Fleck ist. Man muss einen ziemlich freien Überblick über die Gesamtbeleuchtung haben, um den Schlagschatten als solchen zu erkennen. Befindet man sich selbst im Schattenkegel, z.B. nahe vor einer Hauswand, ist es unter Umständen unmöglich, den Schlagschatten zu sehen. Alles vor der Nase ist dann so umfassend beschattet, dass man eine normale Beleuchtung erlebt. Erst wenn man etwas zurücktritt und um den Schattenkegel lichtere Teile des Wahrnehmungsfeldes beobachtet, kann man einen Schlagschatten feststellen. Ist beinahe alles im Wahrnehmungsfeld beschattet und befindet sich nur ein kleiner Bereich in direkter Beleuchtung, dann wird über-

²⁰⁾ Fuchs, W., Zeitschrift für Psychologie 91, 1923, S. 173 ff.

²¹⁾ Bühler, a.a.O., S. 80—81 ff.

haupt keine Beschattung gesehen, sondern die direkt beleuchtete Stelle wird als Lichtfleck empfunden. Wir können demzufolge sagen, dass es keine absolute normale Beleuchtung gibt. Diejenige Beleuchtung, die in dem grössten Teil des jeweiligen Sehfeldes vorherrscht, wird als „normal“ angesehen. Im Verhältnis dazu werden abweichende Bereiche als Schatten- oder Lichtflecke aufgefasst²²⁾.

Katz berichtet über folgenden Versuch: „Eine Landstrasse möge von dem Licht der hochstehenden Sonne getroffen werden. Sie erscheint uns dann mit allen darauf befindlichen Gegenständen „zu licht“.... Nun wollen wir annehmen, die Sonne befände sich in unserem Rücken, so dass wir den von unserem Körper auf die Strasse geworfenen „Schatten“ sehen können. Wenn auch die von unserem Schatten getroffenen Teile der Strasse mehr Licht aussenden als bei normaler Beleuchtung und diese Teile selbst bei ihnen zugewandter Aufmerksamkeit die Strasse uns in ihrer „eigentlichen“ Farbe zu geben scheinen, so haben wir doch bei Beachtung des ganzen Gesichtsfeldes den Eindruck, als läge in diesen Teilen eine *Dunkelheit* auf der Farbe der Landstrasse, die eigentlich nicht zu ihr gehört.“ „Jetzt halten wir einen grossen Pappschild, der allein durch eine kleine Öffnung in seiner Mitte das Sonnenlicht durchfallen lässt, so, dass sein Schatten auf die Strasse fällt. Beachten wir nun Teile des Schattens, so glauben wir die eigentliche Farbe der Strasse unmittelbar erfassen zu können; nur ganz in der Mitte ist dieser eigentlichen Farbe ein heller Lichtfleck aufgelagert“²³⁾.

Zusammenfassend können wir also sagen: Der unter einheitlichem Beleuchtungseinfluss stehende grössere Teil des Sehfeldes wird zum normal beleuchteten Grund, kleinere abweichende Teile werden als Schatten- oder Lichtflecke empfunden. Sind auf einer bestimmten Oberfläche die beiden Bereiche, der beschattete und der belichtete, gleich gross, dann entsteht keine eindeutige „Fleck- und Grund“-Gliederung, sondern man konstatiert ein ähnliches Schwanken wie bei Flächenfiguren, wo zwei Gliederungen derselben Stufe vorhanden sind, von denen keine die Oberhand gewinnt. Es entsteht ein Umschlagsmuster. Mit dieser Gliederung in Fleck und Hintergrund mit gleich-

²²⁾ Bühler, a.a.O., S. 77; Katz, Der Aufbau der Farbwelt, S. 62.

²³⁾ Katz, Der Aufbau der Farbwelt, S. 203.

zeitigem Raumeindruck konkurriert offenbar in einigen Fällen die viel allgemeinere, schon seit langem unter Flächenbereiche bekannte Gliederung in Figur und Grund ohne gleichzeitigen Raumeindruck. Man kann wohl sagen, dass die gewöhnliche Figur-Grund-Gliederung im allgemeinen eine feste, stabile Gliederung bedeutet und dass sie darum auch entsteht, wenn die Bedingungen dazu nur eben vorhanden sind. Die Gliederung in Fleck und Grund erscheint als eine Gliederung höherer Gliederungsstufe und wird, wie überhaupt die Berücksichtigung der Beleuchtung, erst dann einsetzen, wenn die Gestaltgesetze durch die Figur-Grund-Gliederung nicht die höchste Ökonomie der Wahrnehmung erreichen ²⁴⁾. Umgekehrt: werden z.B. Schattenphänomene schon einfach genug als eine Flächengliederung in Figur und Grund erlebt, dann verwirklicht sich diese einfachste Gliederungsweise. Gerade das geschieht im Hering'schen Versuch bei der Umrahmung. Man braucht keinen „Fleck und Grund“, das ist unnötig kompliziert, wenn die Umrahmung eine Figur-Grund-Gliederung gestattet. Eine Umrissfigur hat gewisse phänomenale Eigenschaften gegenüber dem Grund, die den Eigenschaften des Fleckes entgegengesetzt sind. Während der Fleck den Grund durchschimmern lässt, hebt sich bei der Figur-Grund-Gliederung der umrissene Bereich hinsichtlich seiner Farbe besonders vom Grund ab und strebt eine Homogenisierung der Farbe innerhalb der Kontur an. Das alles geschieht im Hering'schen Versuch, wenn die Fleck-Hintergrund-Gliederung vor der Gliederung in Figur und Grund zurückweicht.

Alle Phänomene von Licht und Schatten lassen sich somit unter folgender Hauptregel zusammenfassen. *Es besteht eine Tendenz zur Einfachheit der Wahrnehmungsganzheit.* Die Wahrnehmung folgt dem schon von Mach aufgestellten Prinzip der Ökonomie: Diejenige Gliederung setzt sich durch, die unter den jeweiligen Bedingungen die grösste Einfachheit gewährt. So werden die Umschläge im Hering-Versuch verständlich und ebenfalls Lauensteins Versuche mit geradkantigem und zackigem Brett. Bei geradem Schatten entstand schon durch die Figurengliederung, d.h. also den Streifeneindruck, die höchstmögliche Einfachheit. Lauenstein bemerkt, dass auch der den Randerscheinungen zugeschriebene Anteil beim Schlagschatten gemäss

²⁴⁾ Siehe z.B. v. Fieandt, Zeitschrift für Psychologie 153, 1942, S. 115 f.

diesem Prinzip der Einfachheit zu deuten ist. Etwas Dunkles mit verlaufendem Rand auf weissem Papier ruft niemals den Eindruck einer „Hintereinander-Gliederung“ hervor wie ein wirklicher Schatten. Wenn aber die dunkle Stelle auf der einen Seite von einem scharfen, winkelförmigen Rand begrenzt ist, entsteht die jetzt einfachste Gliederung: die Dunkelheit setzt sich hinter der weissen Ecke fort²⁵⁾. (Fig. 7.)

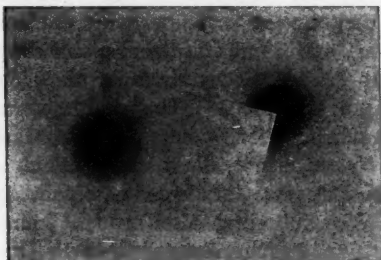


Fig. 7.

Kardos zeigt eine schöne Anwendung des Heringphänomens. Eine runde Scheibe steht im Loch einer Lochtafel. Wird zuerst nur die Scheibe beschattet, tritt phänomenal keine Gliederung in Schatten und Beschattetes ein. Erst wenn man den Schattenspender so verschiebt, dass auch ein Teil der Lochtafel beschattet wird, tritt die Kippe ein. Die runde Scheibe wird weisslicher, und man sieht ihre wahre Farbe durch den Schatten hindurch²⁶⁾. Kardos hat auch hier einseitig die Randerscheinungen des Schattens als Ursache angenommen. In der Tat ist die phänomenal vorliegende Wahrnehmungsweise in der ersten Phase ja auch die gestaltlich einfachste. Auch ohne Schatteneindruck ist die Situation eindeutig genug. In der zweiten Phase ist es wieder viel einfacher, auch die Scheibe als vom Schatten betroffen zu empfinden. Denn sonst müsste im Schatten ein Loch phänomenal vorhanden sein, und das ist wieder viel komplizierter.

Sind diese letzten Erwägungen richtig, dann müssen auch phänomenal die „vor“ und „hinter“-Eindrücke wechseln, wenn man den Vpn die beiden Situationen nach einander vorführt.

²⁵⁾ Lauenstein, a.a.O., S. 295 f.

²⁶⁾ Kardos, L., Ding und Schatten, S. 128 f.

Meine Versuche in Helsinki haben gezeigt, dass es sich wirklich so verhält.

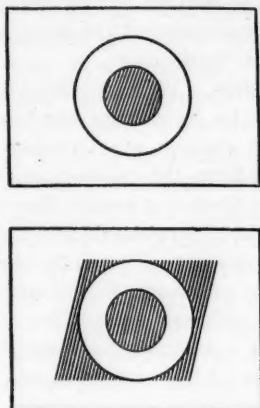


Fig. 8.

Ich möchte mit folgender allgemeinen Bemerkung schließen. Wenn man der Phänomenologie dieser Erscheinungen nachgeht, so ergibt sich daraus nicht nur theoretisch Wertvolles, sondern wir gewinnen auch festeren Boden und einen tieferen Blick für viele praktische Anwendungsmöglichkeiten. Wir haben immer wieder Gesichtspunkte hervorgehoben, die für den Maler von Bedeutung sind. Aber auch die Beleuchtungstechnik von heute wird mehr und mehr die Phänomenologie von Licht und Schatten berücksichtigen.

SUMMARY.

One of the most interesting problems of modern perceptual psychology is how the phenomenally experienced light and shadow correspond to circumstances in the "exterior" physical world of things.

Ever since Leonardo da Vinci we have been accustomed to divide the phenomenally experienced shadows into thing-shadows, space-shadows and cast-shadows. Similarly we speak of thing-light, space-light and cast-light.

1. A *thing-shadow* comes into being when an object, imper-

vious to light such as a bullet is illuminated from one side only. The side that is turned away from the light is left in shadow, which adheres to the surface of the object. Perhaps the best example is the thing-shadow of the moon, owing to which we sometimes see only a "half-moon".

2. *The space-shadow.* When an object is illuminated one-sidedly, it prevents the light from reaching the space behind. The direction of the shadow is determined by the object. The shadow-cone sweeps from the object through the air until it is projected on the new surface it meets. The spatial shadow makes the space occupied by it appear darker than the environment and fills it in the manner of an intermediate element. In a suitable intermediate substance, for instance in clear water the spatial shadow-cone proceeds, suggestive of its reverse phenomenon, the flood of a search-light sweeping the night. With reference to the cone of light sweeping the space we speak of space-light.

3. *The cast-shadow* is certainly the most conspicuous and substantial of all shadows. Phenomenologically, it interests us most of all here. In a great many cases the cast-shadow follows the form and the contours of the illuminated object very closely, especially so when the edge is steep and sharply defined.

Before dealing with cast-shadows the author makes a few comments on thing-shadows and thing-lights.

If one-sided, strongly oblique light strikes a surface with relief-like protuberances and indentations, the thing-shadows appear on opposite edges in the elevations and depressions. The same holds true of thing-lights. A phenomenological consequence of this is that when the sheet is turned upside down, the protuberances are now indentations and vice versa. Perceptually the greatest invariance refers to the direction of the light; the totality is discriminated in a way corresponding to the invariability of the light. (Fig. 1.)

There exists a unity competing with the unity of illumination. The inclination to see all forms as elevations, the protuberance-tendency, is particularly pronounced.

It seems that the discrimination according to the unity of illumination is a fairly high-level articulation, rendered necessary, as a great many other articulations, when lower-level articulations do not produce a sufficiently firm, unequivocal

gestalt. This is the case also in the so-called reversible figures, where two articulations compete with each other. When the protuberance-tendency is strong enough to produce in the gestalt a sufficient firmness, perceived by the observer, the unity of illumination does not materialize.

Already Hering studied the phenomenal cast-shadow as an independent perceptual phenomenon. Particularly famous is his shadow experiment in which a surprising switch-over of the immediate impression occurs as a result of the framing of the cast-shadow. (Fig. 2.) The impression of a transparent shadow hovering above disappears and the shadowed area appears with a different shade of colour as a part of the background; the darkness of the shadow clings more tightly, as it were, to the surface of the ground. In his own explanation of this Hering is inclined to think that one of the chief factors of the phenomenal shadow impression is perhaps the gradual border, the so-called half-shadow area, so characteristic of shadows. When this border area is eliminated by framing, the impression of a shadow disappears. Already Bühler pointed out that the switch-over of the impression in Hering's experiment is by no means exhaustively explained by this theory. Moreover, Lauenstein has shown with careful experiments that the half-shadow border is neither a necessary nor a sufficient condition under which a phenomenal cast-shadow occurs. Her experiments show that no perception of either depth or shadow is realized in the case of a straight edge, when this already brings about an extremely simple gestalt, a black streak on a white ground. (Fig. 3.) On the other hand the shadow attaching to an indented edge is not a good gestalt, in itself, seen as a plane figure. In this unstable state of articulation the perception looks for a new invariance, as it were, and this is achieved by seeing the shadow as an edge of an elevated plane, an edge with an all-round uniformity of height. The articulation that is simpler and which realizes a greater stability proves to be more favoured. (Fig. 4-6.)

The circumstances under which two surfaces are simultaneously seen behind each other, the far one being seen through the near one have been exhaustively enumerated by Fuchs. The stronger the light of the light spot and the deeper the non-luminosity of the shadow patch, the lesser gets the transparency of the patch until the whole articulation into the patch and the

ground disappears. Conversely, the more definite the miniature articulation of the ground surface, perceived through the patch, the more transparent the patch itself.

Furthermore, we must emphasize the role of a factor only touched upon by Bühler. By way of advice to painters he points out that in painting small and narrow cast-shadows we must remember their more effective covering power. When the shadow extends over the whole of the background the "patch and ground" articulation is not realized. The smaller the patch in question is, the stronger is the "patch and ground" articulation. In order to make the cast-shadow appear phenomenally as such, we must have a relatively free general view of the conditions of illumination.

The major part of the field of vision coming within the range of uniform illumination is experienced as a normally illuminated ground. The smaller areas deviating from it as regards their reflection intensity are seen as patches of light or shadow. If on a certain surface both the areas, the illuminated and the shadowed, take up equal parts, no unequivocal "patch and ground" articulation is realized, but a similar switch-over is perceptible that appears in plane figures when in their perception two coplanar articulations compete for supremacy. The result is an impression of change.

The phenomena of light and shadow follow thus phenomenally the following rule: a tendency to simple perceptual totalities is prevalent. The perception follows here, too, the principle of the greatest possible simplicity, emphasized already by Mach and after him by the gestalt-psychologists. The articulation is realized that under the prevailing circumstances permits the perception to follow the simplest route.

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GROUPWORK AND INDIVIDUAL WORK AMONG CHILDREN

by

ANITRA KARSTEN (Helsingfors)

Recent researches in productivity of groups have been focused primarily on the determinants of efficiency of the group achievement. The present experiment differed in that its objective was the study of individual productivity in a group setting.

We want to find out whether the children do more work and persevere at it longer when together in groups than when alone.

The experiment was carried out in the six normal classes and in the two advanced classes in the public elementary school (primary school). In each case the class was divided into two groups. Group A worked freely and the children were allowed to talk and compare their work with children in the same class. Group B worked individually having no contact with the children in the same class and did not even show their work to each other when they had finished.

The task set was to draw the man in the moon (a full moon with a face) as many times as they liked. There was no time limit. The children were allowed unlimited sheets of octave paper and drew on both sides. Their ages varied from 7 to 14. There were 88 children altogether 46 in group A and 42 in group B ¹⁾.

The simple monotonous task was chosen because it was easiest to check exactly the time taken and the quantity done. Composition, painting or school problems would have been more difficult to assess.

Figure 1 shows the time taken in minutes and the number of figures drawn by the children in both groups taken together according to the age of the children. We notice that the two curves are more or less identical.

Figures 2 and 3 show a clear distinction between the two groups, those who worked together (Group A) and those who

¹⁾ I am grateful to Mr. M. Kull who carried out the experiment.

worked separately (Group B). The former worked 30 % longer than the later and did more figures. In every class the time was longer.

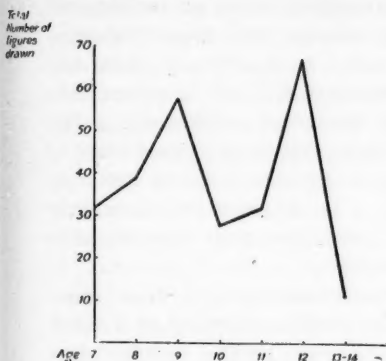


Fig. 1a

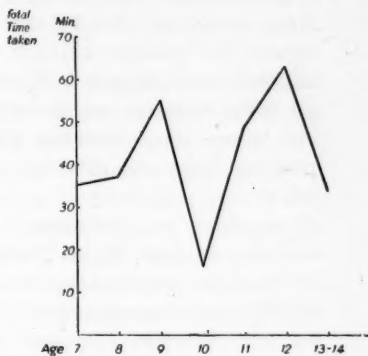


Fig. 1b

The greatest difference is between the 7 and 8 year age group and the least difference in the 11 year age group.

The nine year age group did most when working alone and the twelve year olds when working together. A great change

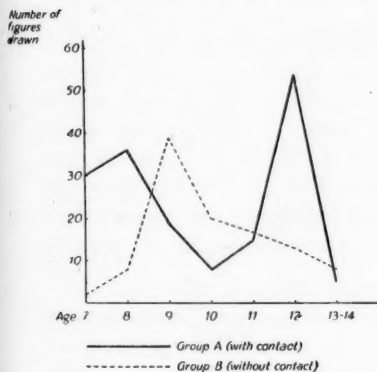


Fig. 2

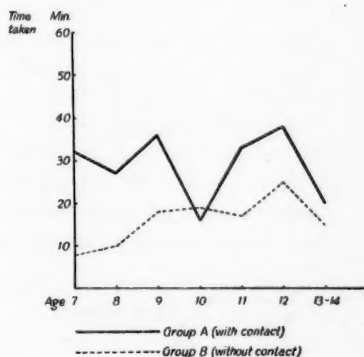


Fig. 3

occurs at 13 and 14 years when the amount of work done when together drops suddenly in group A but only gradually in group B.

One 12 year old child drew the largest number of figures, 153 in 52 minutes (group A). Five 7 year olds in group B drew only one figure each. The lowest number in group A was four.

The youngest children are most influenced by encouragement from each other but by the age of nine have learnt independence. The younger children wanted to do a lot of work and fill their page or pages. They found it difficult to concentrate all their attention on the work when they worked alone but did better when working together, they were stimulated to produce more and to work longer. At nine years of age they were more ambitious to produce a lot of work but could only do so when not distracted by comparing their achievements with one another. Figure 2 shows this.

The older children are more selfconscious and more independent, so at the age of 13-14 the number of drawings is about the same whether they work alone or in groups, but the most

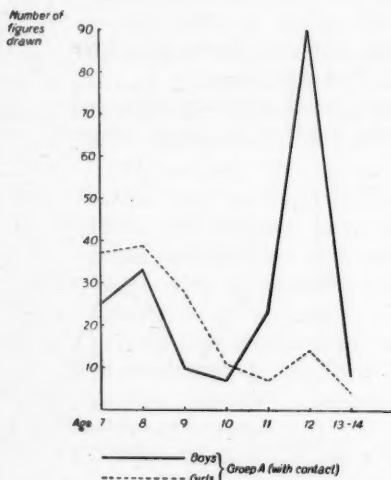


Fig. 4

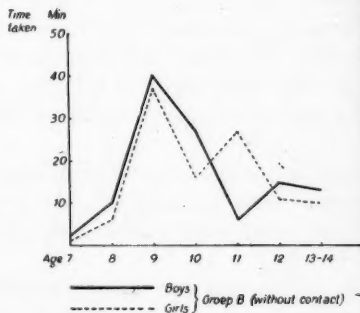


Fig. 5

important point to notice is that the total number in both groups is extremely small.

Boys of 12 did far more work than girls of that age when together and also more — but not nearly so much — when alone.

At 11 years the girls do more and the boys less when alone. (Figures 4 and 5).

It might be true that children work better in groups on work which is not of special interest to them, and that group work in schools is preferable to private coaching for children up to thirteen years of age.

There are subjects and problems which may be better studied alone, perhaps mathematical problems and similar problems.

The children over 14 might do more work in a longer time but that cannot be taken for granted without actual tests of a similar kind being made.

Much more statistical work is necessary before we can draw definite conclusions about the differences between group work and individual work, but there seems to be a clear case for further investigation at the different ages since the older children exhibit such a great variation in the amount of work done in a certain time, when alone and when in groups.

It is also clear that investigation of the structure of various groups is necessary in order to understand the way in which the groups differentially effect individual productivity.

Zusammenfassung.

Wir haben die Frage untersucht, ob Ausdauer und Leistung andere sind, wenn Kinder allein oder in Gruppen arbeiten. Es wurde eine monotone Aufgabe gegeben, Mondgesichter beliebig lange Zeit zu zeichnen. Die Vpn, Volksschulkinder zwischen 7 und 14 Jahre alt, wurden in zwei Gruppen eingeteilt, von denen die eine Gruppe (A) sich unterhalten, die Arbeiten untereinander zeigen und überhaupt ganz frei arbeiten durfte, die andere Gruppe (B) dagegen streng isoliert arbeitete. Es zeigte sich, dass

1. Entweder die Zeit länger oder die ausgeführte Anzahl gezeichneter Figuren grösser war in Gruppe A als in Gruppe B. In manchen Fällen war sowohl die Zeit als auch die Anzahl Figuren grösser in Gruppe A als in Gruppe B.

2. Bei den jüngsten, also 7- und 8-jährigen, Kindern waren die Differenzen in den beiden Gruppen am grössten.

3. Bei den 13-jährigen tritt eine deutliche Veränderung ein. Diese Kinder sind wenig von der Umgebung beeinflussbar. Sie

arbeiten gesammelter, leisten weniger, dafür überlegen sie mehr, arbeiten sie die einzelnen Figuren sorgfältiger aus.

4. Es scheint also, als ob die Gruppenarbeit, jedenfalls für jüngere Kinder, besser ist als das Alleinarbeiten. Für gewisse Aufgaben mag es jedoch notwendig sein, sie allein auszuführen.

5. Für die Beurteilung des Einflusses der Gruppe auf die Produktivität und Ausdauer der Einzelnen, ist eine genaue Analyse der dynamischen Struktur der jeweiligen Gruppe notwendig.

A NEW AUDITORY-VISUAL SYNESTHESIA

by

A. BACHEM

The author has often observed an optical sensation caused by acoustic stimuli. When the eyes are shielded against light (closed or kept in the dark) at the border state between sleep and wake (after late reading), a loud sound (alarm clock, telephone, automobile horn) may cause bright dots to appear, scattered over the whole visual field, with a gradual fading toward the outer periphery. The auditory and visual sensations occur simultaneously, without any noticeable differential latency and without noticeable after-effect or persistency or movement. Thus the sensation differs from the "shooting stars", as seen after strong bodily efforts or falling, usually (perhaps wrongly) attributed to retinal circulation. The phenomenon has some similarity with a drawing of bright spots given by Hess (1), as caused by sudden dim illumination of the dark adapted eyes. v. Zehender (2) mentions that these spots, "die hell-leuchtenden springenden Punkte" occur in the dark also, while all other authors demand dim illumination or even a preliminary strong exposure. The phenomenon seems also to resemble the star vision due to stimulation of area 17, as described by Nielsen and Thompson (3). The sensation has no similarity with vasomotor or pressure auras, as observed in migraine or epilepsy. It differs from the phosphenes, evoked by pressure, accommodation or sudden eye movements. It cannot be provoked by touch or pain stimuli, nor is it caused by sudden voluntary or reflex movements of head or eye lids. Thus the sensation is not indirectly caused by reflexes (as itching of the nose with strong eye exposure, creeping cold after exposure to high pitch tones [Helmholtz's Miterregungen] (4). As a true sensation it is not dependent upon associative activity of the cortex (as in case of colored hearing).

The phenomenon may be explained as a sensory irradiation phenomenon, due to the spreading of nerve impulses from the auditory to the visual pathways, probably from the lateral to the medial geniculate bodies. The spreading occurs only at a drowsy state when higher cortical control is lacking (comparable to mass reflex in a spinal animal). An extremely weak spreading appears sufficient to evoke the scattered star sensation on a completely dark background.

The phenomenon is not noticeably affected by sleeping drugs in low dosage nor by high doses of vitamin A or B.

While other synesthesias and entoptic phenomena are reported, quoted and requoted by many authors, this phenomenon has not been described before. The only visual effects of auditory stimuli reported (5, 6, 7) are of a "facilitative", "dynamogenic" nature. A confirmation of the phenomenon by other observers would seem valuable.

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THE EDUCATIONAL AND THE RESEARCH WORK IN PSYCHOLOGY AT THE UNIVERSITY OF AMSTERDAM

by

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Systematic training in scientific psychology at the University of Amsterdam began with the foundation of the Chair of Psychology and the installation of the psychological laboratory in the year 1931.

The task of scientific psychology is a dual one: training and research. The former, again, is divided into two parts: the theoretical and the practical.

1. *Training*

The theoretical training consists of teaching of the scientific foundations of all psychological work. This is the necessary basic condition of any independent scientific work and is indispensable if we aim at a critical attitude towards different currents of thought and the methods which are being applied or advocated. The duration of our theoretical course is about $2\frac{1}{2}$ years, ending with the "Candidate"-examination (comparable to the B.Sc. degree), which covers the subjects Psychology, as the main subject, and Philosophy, Biology and Physics, as auxiliary subjects. This first examination is preceded by a number of preliminary examinations, by the tutors, and covering the Introduction to general and experimental psychology, genetic and child psychology, psychodiagnosis and laboratory work generally.

Another $2\frac{1}{2}$ years' study is required for passing the "Doctorandus"-examination (comparable to the M.Sc. degree), which covers the subjects Psychology, Psychopathology, and a subject left to the candidate's own choice, e.g., sociology, economics, etc. Before the candidate is admitted to this examination, he or she must also pass a preliminary examination in certain parts of applied psychology, namely, psychotechnics, characterology, and

social psychology. Moreover, candidates are expected to produce one or two short theses.

For obtaining the degree of Doctor of Psychology, authorship of a larger and scientifically important work is an essential condition; this degree, therefore, cannot be obtained until several years after the Doctorandus (M.Sc.) degree.

At the present time, at our University, no less than 250 students are studying psychology as their main subject. Experience teaches us, however, that not all of these students are able to fulfil eventually the demands imposed upon them. For this reason we have introduced a fairly severe system of psychotechnical tests in order to determine an applicant's preliminary qualifications to follow university training courses in general and psychology lectures in particular. We have also recommended the introduction of similar psychotechnical tests for all would-be students at universities generally. (Vide: *Nederlands Tijdschrift voor Psychologie* III. 1948).

The long period of training and the research-work requires a large laboratory and a considerable number of co-workers and assistants. The psychological laboratory of the University of Amsterdam comprises of 34 rooms, a lecture room, library, workrooms, dark room, and other rooms, the whole being housed in two old five-store patrician houses on one of the largest "grachten" (canals) of Amsterdam. The staff consists of 18 persons: the Director Prof. Dr G. Révész; Prof. Dr H. C. J. Duijker; 4 heads of departments: Dr Maria C. Bos and Dr A. D. de Groot, Associate Professors; Dr T. T. Ten Have and Dr Rita Vuyk, lecturers; 2 Head Assistants: J. Voskuyl M.D. and Drs C. F. van Parreren and 8 Assistants.

2. Research Work.

It is impossible to limit the whole field of psychological investigation, there being, after all, no aspect of either human or animal behaviour whose manifestation does not require a psychological investigation and explanation, as the present writer argued in his book "*Bedeutung der Psychologie für die Wissenschaften*". (The Significance of Psychology for other Sciences, Bern 1947).

In order, however, to give the reader a closer view of the vast extent of this field of research, we may here point to the most

important subjects of investigation dealt with by our Laboratory in the course of the last 18 years.

Psychology of Sensation was dealt with from the optical, acoustic and tactile angles. The observation of form by means of touch was especially subjected to a thorough investigation, which enabled us to place the principles of "haptics" on a sound foundation. It was shown that these principles do not correspond to those of optics, and that the laws formulated by the gestaltists in regard to haptics have no validity. As against this we have proved that practically all optical errors have their tactile counterpart. Our haptical investigations led us to examine and elucidate the interaction of the various functions of the human hand ¹⁾. In the field of optics we especially dealt with the problem of binocular sight, while in acoustics we investigated binaural sound-mixture, both theoretically and experimentally.

The problem of natural endowment formed the theme of several publications issued by the Laboratory, more especially that of musical talent, mathematical endowment and that for chess-playing. One of the theses dealt for the first time with the question of "chess-thinking", on the basis of an experimental and thought-psychological investigation.

The subject of three important investigations was the result of collaboration by 2—3 workers. It was found that collective work produced a surprisingly great improvement in the results both quantitative and qualitative. The collective work yielded results unobtainable by division of work undertaken by single individuals.

Child-psychological investigations were conducted in the normal, blind and deaf-mute children. A considerable quantity of experimental material, moreover, was gathered on the subject of the highest level of logical-methodical thinking in children between the ages of 4 and 10.

In recent years the Psychology of Language has come to the forefront. Verbal and non-verbal means of communication between living beings in general have been elucidated, and the pre-history of human speech and its principal functions has been subjected to studies which have led to the development of new theories and hypotheses.

¹⁾ The investigation of the sense of touch afforded an opportunity to test the aesthetic observation processes and plastic activity in the blind.

Contributions were also made to the knowledge of educational psychology, test-psychology, social and mass-psychology, and industrial psychology.

In the field of animal psychology, spatial observation, tactile memory, and comparison- and identification-processes were investigated, fresh light being thrown on the question of the autonomy of the science of psychological anthropology as against animal psychology. To assist the students in practical training, direct tests were made on children, young people and adults in our child-psychological and psychotechnical departments. At these tests the students work as auxiliary assistants, and are afterwards given the opportunity, when the reports of the cases are written and elaborated, to get acquainted with the methods used in the psychological practice.

Detailed communications concerning the activities of our Psychological Laboratory may be found in the International Journal of Psychology: *Acta Psychologica*, Vol. V, Amsterdam 1941.

